THE ENGINEER

The International Machine Tool Exhibition at Olympia

Descriptive Supplement No. II

IN this, the second Supplement dealing with the International Machine Tool Exhibition, we continue our descriptions of a selection of the wide range of British, Continental and American machine tools which are to be seen at Olympia. The products of a number of other manufacturers will be dealt with in succeeding issues of THE ENGINEER.

Churchill Machine Tool Company, Ltd.

For many years the Churchill Machine Tool Company, Ltd., of Broadheath, near Manchester, has specialised in the design of grinding machines, and its exhibits include a number of new and improved machines.

One of these new machines is the fully automatic plain grinder we illustrate in Fig. 1 and which has a maximum grinding capacity of 4in diameter and 12in between centres. The 24in diameter grinding wheel fitted is larger than the wheels normally used on machines of similar capacity and it is mounted on a spindle running in a new and improved type of parallel bearings.

A balanced constant-speed 3 h.p. motor mounted at the rear of the wheelhead drives the spindle through vee belts. The dead centre workhead of the machine is driven by a ¼ h.p. stator and rotor unit, and a three-step cone pulley transmits the drive through vee belt from the rotor to a countershaft. Final drive to the workhead faceplate is by a totally enclosed duplex chain running in an oil bath, the three work speeds available being 294, 591 and 898 r.p.m.

In the hydraulically controlled tailstock the barrel carrying the work centre is rack propelled forward under the action of a compression spring and is withdrawn through the medium of a hydraulic piston. The cylinder carrying this piston is interconnected with the hydraulic cylinder operating the "Fulcro-Sizer" motion to the table of the machine. The firm's "Fulcro-Sizer" motion operates on a fully automatic cycle using the principle of feeding the work to the grinding wheel instead of feeding the wheel to the work. By the use of this system of operation it is claimed that automatic sizing to plus or minus 0·00005in is possible on long runs of components. In the fully automatic cycle of operations the component is first placed on the work cradle mounted on the table. Then, on the cycle starting control lever being moved by the operator, the tailstock barrel carrying the work centre moves in automatically and picks up the component between centres; work rotation starts and simultaneously an electro-hydraulic control unit actuates the tilting mechanism of the table. The table tilts forward towards the grinding wheel, quickly at first and then at a gradually reducing rate, until the size or maximum lift position is reached. In this size position the table dwells (if desired) to build up high finish, after which the control unit again comes into operation and the table quickly returns to its original position. At this stage the work rotation stops and the tailstock barrel carrying the work centre is hydraulically withdrawn, leaving the finished component on the work cradle ready for removal and for the insertion of the next component.

Special arrangements have been made in the most recent design of "Fulcro-Sizer" mechanism to ensure that the cycle time does not vary due to the heating of the hydraulic oil and consequent change of viscosity. For this purpose a small motor-driven metering pump is mounted above the control unit to control the exhaust circuit and to maintain a constant speed of operation of the cycle time.

The table of the machine is hydraulically driven by a directly coupled piston-rod and two independent hydraulic circuits are used, one for the sizing motion and the other for the table traverse. Interposed between the table traverse pump and the table cylinder is a new design of hydraulic reverse valve incorporating a specially sensitive pilot valve actuated by adjustable trip dogs mounted on the front face of the table.

The firm's model "BW" 10in plain grinding machine, which is being exhibited with a hydraulic diminishing feed and automatic sizing cycle, is illustrated on Plate 1. Normally this machine uses a 20in diameter by 2in wide grinding wheel, but is shown fitted with twin grinding wheel equipment for grinding two diameters simultaneously. The grinding wheel forming device is permanently mounted on the back of the wheelhead and a stepped former bar is used to true the two grinding wheels in correct relationship to the diameters of the work; the diamond is traversed across the wheel faces by a

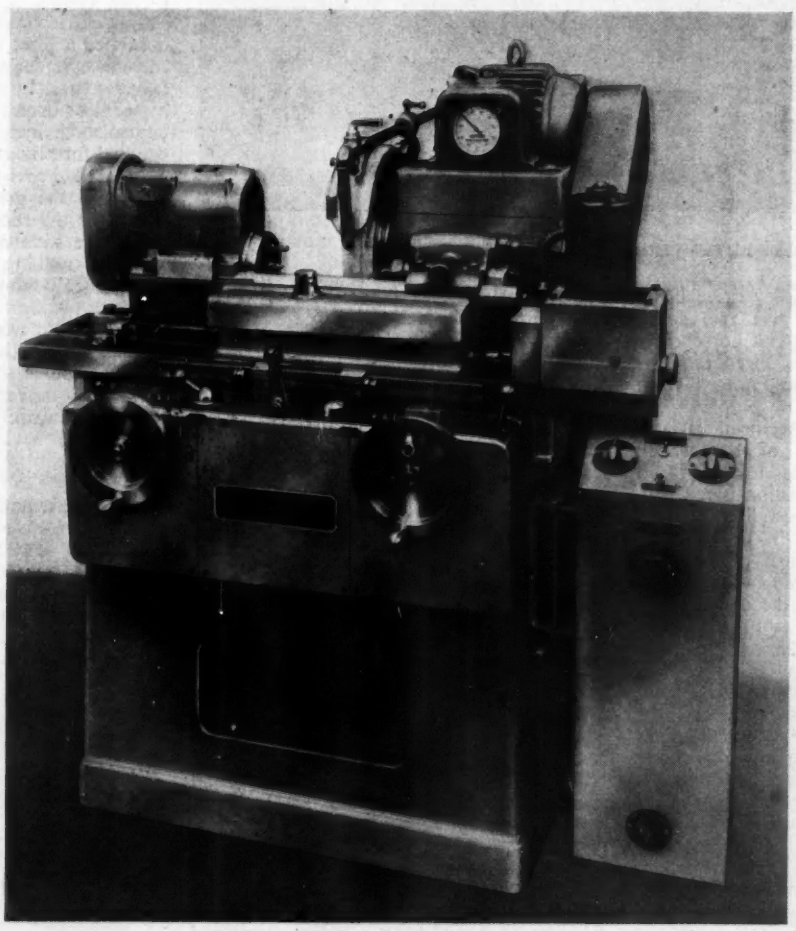


Fig. 1—Automatic Plain Grinding Machine—Churchill

hand-operated screw and nut arrangement.

The table traverse is hydraulically driven and has an infinitely variable speed range from zero to 192in per minute, controlled by a balanced piston hydraulic valve. A 2 h.p. hydraulic pump motor drives two geared oil pumps in tandem. One pump operates the hydraulic table traverse and the other the wheelhead traverse, which is run on a separate circuit.

The dead centre workhead is driven by a variable-speed motor with a 6 to 1 speed range, a two-speed cone pulley drive being incorporated in order to give two speed ranges and to maintain the full horsepower at slow speeds. Its bottom speed range is 20–120 r.p.m. and the top speed range is from 50–300 r.p.m.

The automatic sizing wheelhead gives a quick forward movement of the wheel, followed by a diminishing forward feed movement until the size position is reached. At this point an automatic dwell comes into operation and the wheel is allowed to " spark out " to build up finish. This period of dwell is variable and may be eliminated if required. At the end of the dwell period the wheelhead runs back at its top speed to the starting position to complete the automatic cycle.

A newly designed 36in by 168in plain grinding machine exhibited represents the firm's latest effort to produce a machine of heavy dimensions, which is light and sensitive to control and easy to operate. All controls are conveniently grouped in the natural operating position and power motions are incorporated in the table and wheelhead traverse motions. Hand, automatic and power traverse motions are fitted to the wheelhead, the automatic feed being applied at each reversal of the table through the usual feed and ratchet motions.

In the dead centre workhead a 10 h.p. motor drives through multiple vee link belts to an eight-speed gearbox, giving speeds from 12·5 r.p.m. to 75 r.p.m.

The work table traverse is gear driven from a three-speed motor running at 700 r.p.m., 940 r.p.m. and 1440 r.p.m. and driving through multiple vee belts to a five-speed gate change gearbox, the combination providing a range of fifteen table traverse speeds from 5·69in to 122·97in per minute.

Special attention has been paid in the design of the reverse mechanism to eliminate shock, inaccuracy of stroke and noise at the point of reversal and to enable the traverse to be reversed within a few thousandths of an inch. In this hydraulically controlled reverse mechanism dogs fitted to the table impart a swivel motion to the table reverse lever which is coupled to a rocker arm contacting two lightly loaded ball valves controlling ports in the reverse valve. From these ports the oil is directed to an auxiliary piston valve, which is directly coupled to the clutch operating lever in the reverse gearbox. A new " Hydrostatic " system of lubrication for the table slideways ensures a complete fluid film between the sliding surfaces without movement of the slides themselves and remains unaffected by the load.

The bed of the machine is 432in long and the work table does not at any time extend beyond the ends of the body.

The firm's latest design of 10in by 24in universal grinding machine is also shown on Plate 1. It has a fully universal wheelhead carried on substantial slides arranged to swivel through 180 deg. and the feed can be applied in any direction irrespective of the angle of setting. The internal grinding spindle carried in a swinging bracket mounted above the main spindle enables a quick change to be made from external to internal grinding without removing the external grinding wheel. An independent motor drives the internal spindle and a safety reversing switch is provided to cut out the main spindle driving motor when internal grinding.

The hydraulic table traverse of the machine is operated by a direct-coupled piston-rod and traverse speed is infinitely variable up to 180in per minute. A quickly adjustable dwell is fitted to the table motion, which is also arranged for fine or coarse hand operation, the power and hand motions being hydraulically interlocked. The top table swivels up to 9 deg. included angle.

The workhead, which is arranged for both live and dead centre grinding, swivels up to 90 deg. towards the grinding wheel and 45 deg. in the opposite direction. It is driven by a variable-speed motor and the control gives a 6 to 1 speed range, which is doubled by a two-step cone pulley drive, resulting in two continuously variable-speed ranges of 29 r.p.m. to 175 r.p.m. and 67 r.p.m. to 400 r.p.m.

The automatic cycle internal grinding machine, shown in Fig. 2, is designed on completely new lines and can be used for plunge-grinding with or without oscillation and is also suitable for the grinding of long bores. Power for the workhead is provided by a 1½ h.p. constant-speed motor driving through multiple endless vee belts to a ball bearing countershaft. The final drive to the spindle is by a single endless vee belt and a four-step cone pulley giving spindle speeds of 97 r.p.m., 157 r.p.m., 236 r.p.m. and 344 r.p.m. The workhead is mounted on a swivel base, providing an angular movement of up to 30 deg. for taper grinding.

In this design of machine the workhead slide is mounted on rollers and is moved transversely across the body to provide the necessary feed to the work whilst the grinding wheel spindle traverses into the bore on a fixed path.

A 5 h.p. constant-speed motor running at 2900 r.p.m. is used to drive the wheel spindle through a flat endless belt to a countershaft pulley, and from the countershaft drive to the spindle is by a second flat belt. A sliding carriage upon which the wheel spindle is carried is directly coupled to the hydraulic traverse cylinder and the length and speed of traverse is set by dogs mounted on a circular segment or drum. The setting of these dogs controls the hydraulic valve to give instant reversal for plunge cut grinding and for blind end holes. Provision is also made for a quick run-in to the grinding position, and slow-down for the rough grinding traverse, after which the slide returns to the wheel truing position, making two passes of the wheel across the diamond and then returning to the grinding position for the finish grind, at the completion of which the wheel slide returns to the start position at top speed. The work feed motion is also hydraulically operated, the actual movement being governed by a special feed cam.

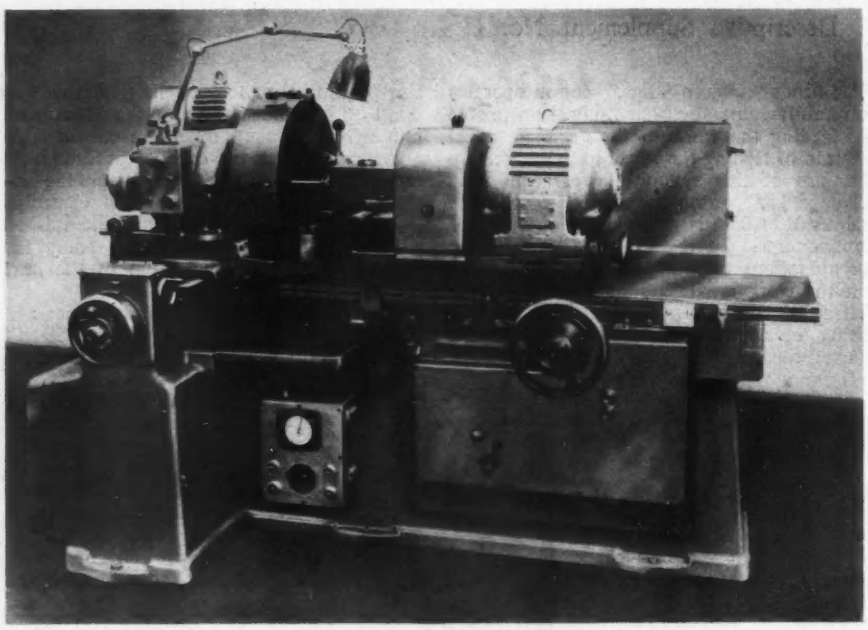


Fig. 2—Automatic Sizing Internal Grinding Machine—Churchill

Taylor, Taylor and Hobson, Ltd.

A new instrument of particular interest to industry which is to be seen upon the stand of Taylor, Taylor and Hobson, Ltd., of Leicester, is the " Talyrond " apparatus for measuring the roundness of parts such as balls, pistons, cylinders, &c. This machine,

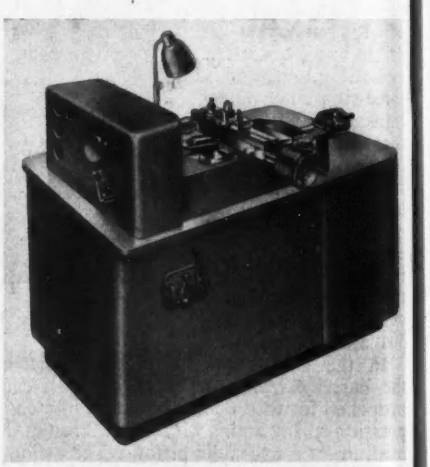


Fig. 3—Turning and Thread Chasing Lathe—Taylor, Taylor, Hobson

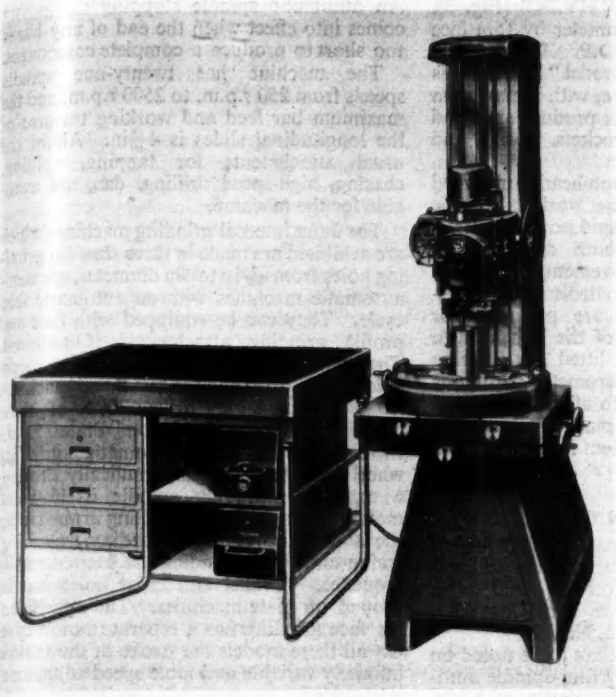


Fig. 4—Roundness Measuring Apparatus—Taylor, Taylor, Hobson

which is illustrated in Fig. 4, is designed to check external diameters from $\frac{1}{16}$in to 12in and internal diameters from $\frac{1}{2}$in to 12in on specimens up to 18in high. As can be seen, it consists of a rigid base unit carrying a table and supporting a column on which there is mounted an adjustable head unit.

The head has an electric displacement indicator, which is carried on an optically worked precision spindle of extreme accuracy. This indicator is rotated round the inside or outside of the part to be examined, which is set on the table and remains stationary. The signal from the indicator is amplified and then applied to a new form of polar co-ordinate recorder giving straight radial ordinates on inkless "Teledeltos" paper. The recorder is mounted at the left-hand side of the spindle and rotation of the chart is synchronised with that of the indicator spindle. A centring device can be mounted on the work table to facilitate the initial centring of rings and other small parts, whilst adjustments situated round the spindle housing provide for fine centring. To permit measurement of components which do not allow the use of the centring attachment, this fixture is made readily removable from the work table. Provision is made for a movement of the work table up to $\frac{1}{2}$in in each direction relative to the spindle to enable heavy specimens to be set with the minimum of time and effort.

The makers of the apparatus point out that the graph normally obtained shows the amount by which the periphery of the work being tested departs from a truly circular form with an accuracy limited only by the residual error in the spindle, and this error is stated not to exceed 3 micro-inches. All the principal irregularities on the specimen are shown.

This company's standard model No. 3 "Talysurf" measuring instrument for determining the roughness of the surface of machined components has up till now had a limitation on the size and shape of the components with which it could be used. In these instruments the principle of the standard "pick-up" entails the use of a rounded skid or shoe which slides over the crests of a surface and provides a datum relative to which the up-and-down movements of the recording stylus are measured. With it the measurement of surfaces of components such as watch parts, races and gear teeth were not possible, so a new datum attachment which is independent of the work surface has been introduced to bring such components within the scope of the instrument. This new attachment, when used with the standard pick-up, guides the diamond stylus in any desired path in the form of a straight line or true radius.

Taylor, Taylor and Hobson engraving machines, pantograph milling and die-sinking machines, &c., shown on the stand have long been known to industry, but visitors will be interested in a 3in turning and thread chasing lathe, which has been added to the machine tools the firm now makes. This machine was originally designed for exclusive use in the firm's works for the manufacture of precision lens cells, microscope objectives, eye pieces, &c. It is intended for turning and chasing at one chucking components from $\frac{5}{8}$in to 6in diameter, and turning up to 3in in length. By employing a number of tools at one setting high speed, precision, repetitive work can be carried out on the machine.

In this machine (see Fig. 3) a series of tools up to six in number are mounted directly in holders on a long slotted slide. The main longitudinal slide and the tool cross slide have drums on their screws, and these drums are fitted with six stops. The drums are graduated in thousandths of an inch and the stop plates in hundredths, and with their use it is claimed that it is quite practicable to hold both diameters and lengths, either plain or threaded, to 0·001in. The tools are selected and positioned with reference to the cross slide drum and stops, and fed in with reference to the longitudinal drum and its stop plates.

Thread chasing is effected by reciprocating the workhead of the machine relative to a fixed chaser and under the control of a master screw situated at the rear end of the work spindle in engagement with a fixed nut. The spindle has four speeds from 650 r.p.m. to 2000 r.p.m. forwards and a single forward and reverse speed of 330 r.p.m.

W. E. Sykes, Ltd.

The gear cutting machines exhibited by W. E. Sykes, Ltd., of Staines, Middlesex, include three new models, which are being shown for the first time by the firm.

One of these machines, the "V.4." vertical gear generator, produces external and internal spur and helical gears up to 45 deg. and 16 D.P. with a maximum of $4\frac{1}{2}$in diameter and $\frac{7}{8}$in face. When fitted with a rack cutting attachment the machine produces racks with either straight or helical teeth, and intricate profiles can also be machined. The same cutter is used to generate external and internal gears and racks with any number of teeth of the same pitch, pressure and helical angles. In this machine pinion cutters are mounted on a vertical reciprocating spindle, and a positive idler stroke cutter relief operates on the cutter head itself, the work remaining steady. Automatic infeed is incorporated and, by simple adjustment of a shoe, work can be completed in one or two stages. At the end of the cutting cycle the machine stops and the saddle retracts. The machine is driven by a two-speed motor and vee pulleys and six cutting speeds are provided.

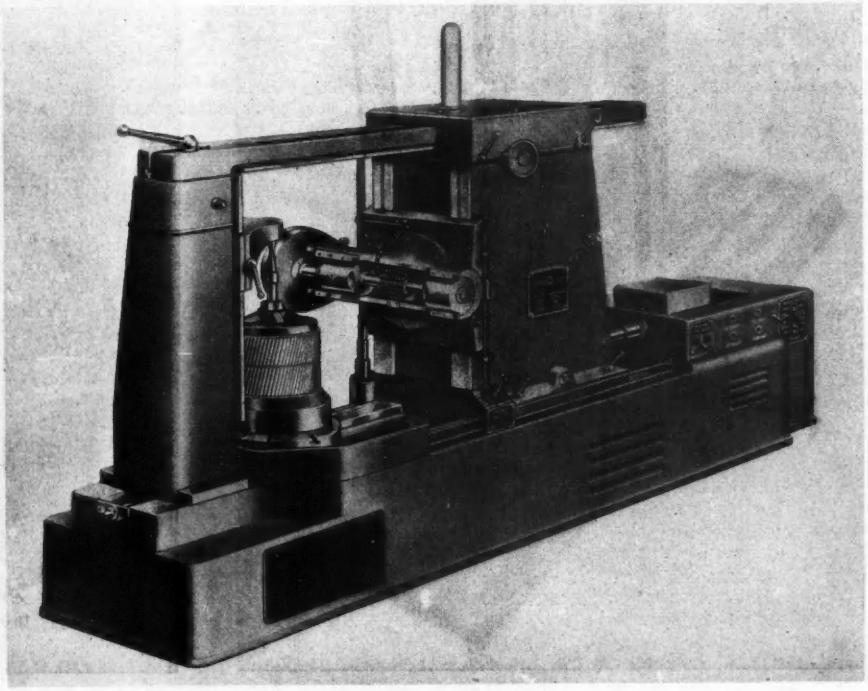


Fig. 5—Universal Hobbing Machine—Sykes

With a capacity of 14in diameter, 2½in face and 6 D.P. the well-known model "V.10A" vertical gear generator, shown in Fig. 6, produces a similar range of external and internal gears to that by the "V.4" machine. Rack cutting attachments are available in 12in,

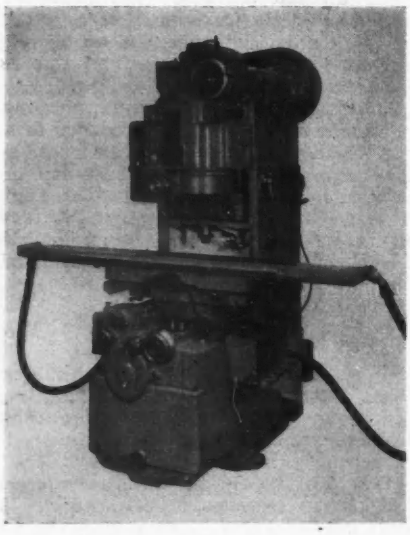


Fig. 6—Vertical Gear Generator—Sykes

24in and 36in sizes, and the machine illustrated is fitted with a 36in attachment. A separate attachment enables contrate gears to be produced, if required. The automatic infeed can be set to finish the work in one, two or three stages by simple adjustment of two rollers, and on completion of a cycle the machine stops and the work retracts.

Of two new universal hobbing machines shown, one—the model "HV.24" (Fig. 5), has a capacity of 24in diameter by 15in face with a maximum of 3½ D.P. The capacity of the second machine—model "HV.40"—is 40in diameter by 19in face, with a maximum of 3 D.P. Both machines produce spur and helical gears, splines, sprockets, worms, and worm wheels.

In these machines the hob head is mounted on a moving column, the work table axis remaining stationary. Rapid power traverse, which is provided in both directions of column and hob slide movement, is operated by a single lever, the controls being interlocked. Vernier scales are provided for accurate angular setting of the hob head, a micrometer device being fitted for centring the hob. A large micrometer drum is fitted to regulate the depth of cut. Optional equipment for these machines includes differential feed gear and an interchangeable axial feed hob head.

Rockwell Machine Tool Company, Ltd.

No less than eighty machines, mainly of American and Continental manufacture, are to be seen in operation on the stand taken by the Rockwell Machine Tool Company, Ltd., Welsh Harp, London, N.W.2.

Many points of interest are to be noted on the new 1¼in bar capacity four-spindle automatic made by Alfred H. Schutte, of Koln-Deutz, which is illustrated on Plate 3. This machine has two cam shafts, which run along either side and all the cam drives have adjustable levers, thus making it possible to cover a wide range of feeds with one set of cams. In addition to its four independent cross slides the machine has four independently operated longitudinal slides, making it possible to select the correct feed rates for each spindle position. If required, one or two additional cross slides can be fitted. An automatic spindle stopping mechanism comes into effect when the end of any bar is too short to produce a complete component.

The machine has twenty-one spindle speeds from 250 r.p.m. to 2500 r.p.m. and the maximum bar feed and working traverse of the longitudinal slides is 4 $\frac{13}{16}$in. All of the usual attachments for tapping, drilling, chasing, high-speed drilling, &c., are available for the machine.

The Jung internal grinding machines which are exhibited are made in three sizes for grinding holes from $\frac{1}{32}$in to 6in diameter, are semi-automatic machines with an automatic feed cycle. They can be equipped with face and profile grinding attachments if required. The smallest machine of the three has a mechanical table drive and the two larger machines a hydraulic table drive. One of these machines is illustrated on Plate 1. In these machines the automatic grinding wheel feed is operated hydraulically through a cam, the grinding spindle itself being mounted in a radially swivelling arm. Under the automatic feed cycle loading, roughing, truing and finish grinding are carried out in sequence. Parallel ann taper holes can be ground on these machines. The attachment for face grinding has a separate motor drive. On all three models the stroke of the table is infinitely variable and table speed adjustment is provided.

A Rockford openside hydraulic planing machine demonstrated has an 84in long table with a direct hydraulic drive giving a stroke of 74in. The toolhead of this machine is carried on a heavy adjustable rail having a rigid brace extending the full width of the column. The tool slide has power feed in both directions.

The table has an infinitely variable cutting speed range from 0 to 110ft per minute with variable return speed of from 0 to 160ft per

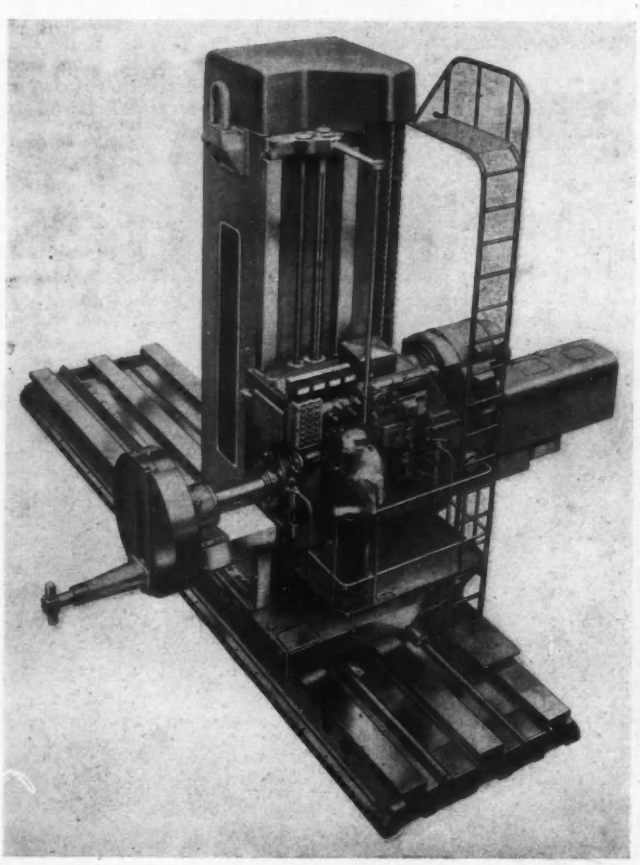


Fig. 7—Boring, Milling and Drilling Machine—Rockwell

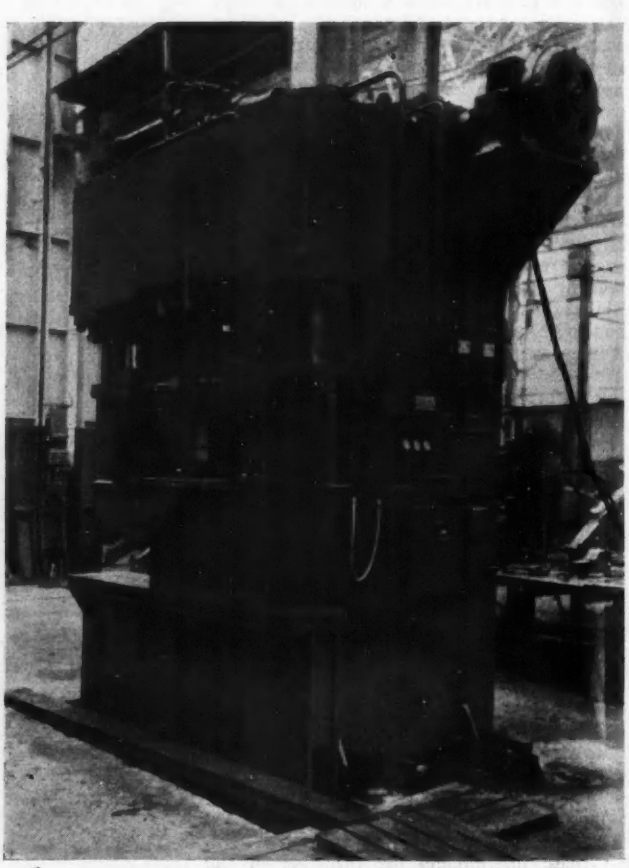


Fig. 8—Press Brake—Rockwell

minute. The machine is fitted with the "Kopy-Kat" attachment developed by the makers. Basically this duplicating unit is a servo mechanism incorporating a stylus, duplicator valve, duplicator cylinder and toolhead assembly, and it is powered by a separate hydraulic system. The stylus is mounted in reciprocating bearings so that it is held lightly but firmly against the template or master. The duplicator valve is of statically balanced rotary valve design and with its helically milled ports a maximum port area is exposed for a given stylus movement. This valve directs the oil to the duplicator cylinder. A rise or fall in the template or master actuates the valve to direct just enough oil to the top or bottom of the duplicator cylinder to result in a corresponding movement of the piston. Since the toolhead slide is suspended from the duplicating piston, the tool follows the same path as the stylus. Direct hydraulic connection assures positive and instantaneous response.

The new design of 30in. "Victomatic" milling machine, illustrated on Plate 4, is intended particularly for high-speed mass or batch production work and is to a large degree automatic in operation. It has a fully automatic two-way milling cycle with single plunger table control, and its differential table drive eliminates the use of clutches and mechanical interlocks when changing from quick traverse to feed. A built-in ammeter which shows power consumption of the spindle drive motor indicates when it is necessary to regrind the cutters. The spindle, feeds and fast traverses of the machine are operated by independent electric motors.

The headstock, which is rigidly clamped to the massive column, carries an 8 h.p. stator rotor unit which drives a splined extension of the spindle through change gears and a single helical gear reduction, giving twenty-four spindle speeds from 30 to 1100 r.p.m. It carries a well-ribbed overarm and two arbor supports, the whole assembly being adjustable vertically through bevel gears and a screw. A tubular column at the front of the overarm provides a rigid additional means of support from the main bed casting of the machine.

The table is driven by a screw and adjustable nut, the nut taking its drive from a feed box which is mounted at the end of the bed. In this feed box the power for feed and quick traverse is transmitted through differential gearing, the feed motion being derived from a 1½ h.p. motor operating through a back gear and slip-on gears, whilst the quick traverse movement is provided by a 1½ h.p. stator rotor unit housed in the feed box. The table has twenty-four feeds from 1in to 40in per minute and its quick traverse rate is 140in per minute.

When operating automatic cycles the machine is controlled through a system of trip dogs operating individual switches housed in the brace-strut casting at the front of the machine. A push-button panel, together with an automatic/manual selector lever is mounted in a convenient position in front of the operator.

One of the largest machines on the stand is a Giddings and Lewis "570 F.U.A.R." model horizontal boring, drilling and milling machine fitted with a 7in main spindle and a 2½in auxiliary spindle. This machine (see Fig. 7) can be fitted with various sizes of tables up to 8ft wide by 30ft long, and a vertical headstock having a travel up to 12ft. An underarm support can be fitted with an angular milling attachment, a roller bearing spindle support, a shaping attachment, or a continuous feed facing head. This arm travels with the spindle to give it rigid support up to the fully extended position.

The main spindle of the machine, which has a longitudinal travel of 60in, is driven by a 40 h.p. motor and there are one hundred spindle speeds from 2 to 400 r.p.m. available. Twenty-one rates of spindle feed range from 0·005in to 0·250in or 0·010in to 0·500in per revolution.

The British Clearing equipment exhibited includes the new fully automatic press brake of 150 tons capacity illustrated in Fig. 8. This machine is 6ft 6in wide between the uprights and the stroke of the slide is adjustable up to 6in. It has a press speed of 86in per minute and a return speed of 490in per minute.

In this machine the hydraulic power is applied to the slide by means of two cylinders, situated one at each end of the machine. The rams of these cylinders contact the slide through machined concave-convex surfaces designed to equalise the load. Two separate smaller cylinders serve to retract the slide from the work.

The slide is adjustable for height relative to the bed at any constant position of the working stroke by means of a small electric motor controlled by a convenient reversing switch. The slide moves in substantial vertical guides provided with adjustable gibs and arranged for adequate grease lubrication. Its working edge is machined to take standard clamps, which are supplied in sections to facilitate the mounting of short tools. Provision is also made for fixing brackets when a wide slide face is required.

The frame of the machine comprises two massive steel upright end members, securely tied together by the box section crown which contains the oil tank and carries the pumps, motor, valves and piping. The bed is very strongly constructed of heavy steel plate and is mounted on the frame by means of steel cylindrical surfaces arranged to transmit the loads to the centre lines of the upright members. Both bed and slide are of deep section designed to limit the deflection under full load to the lowest practicable amount.

The main cylinders are securely attached to the frame in such a manner as to absorb the forces and reactions without distortion and to ensure the most favourable distribution of stresses.

Dean, Smith and Grace, Ltd.

From the seven lathes to be seen upon the stand of Dean, Smith and Grace, Ltd., of Keighley, we have selected two for purposes of illustration, a 26in swing machine and a 17in swing precision toolroom lathe.

The larger of these two machines (Fig. 9) is one of many the company makes with a wide range of cutting speeds suitable for work with both tungsten carbide and high-speed steel tools, and of ample power for using negative rake tools. It combines versatility with ease of operation. It swings up to 28½in over the bed covers and takes 132in between centres—machines of this design being available with centre distances up to 228in in increments of 2in.

The all-geared headstock is driven through vee belts from a 20 h.p. motor and it is designed to give twenty-four forward spindle speeds from 5·4 to 420 r.p.m. or alternatively twelve forward and twelve reverse speeds. Speed selection is simple and rapid through the setting of three levers projecting from a graduated central boss in the head. The final drive to the spindle is by helical gears on the fast speeds and a large spur gear on the slow speeds, both of these gears being fixed rigidly to the spindle.

A totally enclosed dial change feed box gives forty-eight sliding feeds from 8 to 450 cuts per inch, and a similar number of surfacing feeds from 16 to 900 cuts per inch are available. When using the standard set of three change gears forty-eight threads from 1 to 56 t.p.i. can be cut, and with six extra change gears the machine can cut pitches up to 8in and from 0·5mm to 250mm.

The toolroom lathe shown on Plate 2 is designed to swing up to 18in diameter over the bed and is made with two lengths of bed to take 36in or 48in between centres. Its headstock, which is driven by a two-speed 7½–3¾ h.p. motor, is generally of similar design to the standard lathe described above. It gives thirty-six forward spindle speeds from 3·9 to 720 r.p.m., and the spindle is bored to take bar up to 2½in diameter. The machine has a dial change feed gearbox, through which forty-eight sliding feeds from 14 to 800 cuts per inch and forty-eight threads from 2 to 112 threads per inch are available. On this gearbox a chart for indicating the position of the levers carries an indicating frame, which can be moved along by rotation of a knob. When the frame is positioned over the required thread or feed the necessary setting arrangement is shown on columns enclosed within the frame.

The low spindle speeds available down to 3·9 r.p.m., together with the machine's coarse pitch screwcutting motion, giving up to 7in lead, make the lathe suitable for relieving a good range of hobs without the use of a speed reducer. Through the relieving unit incorporated in the machine work with up to twenty flutes can be relieved. This relieving mechanism is engaged or dis-

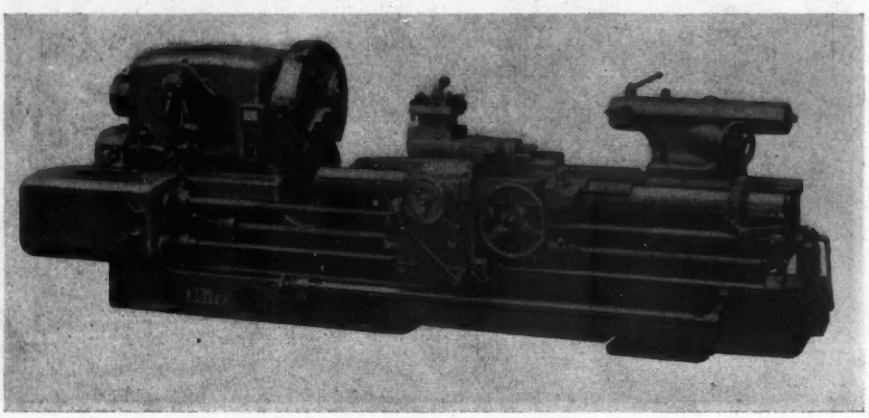


Fig. 9—26in. Swing Lathe—Dean, Smith and Grace

engaged by pulling out a knob on the headstock, and no part of the relieving motion interferes with the normal operation of the lathe.

The relieving cam under the swivel slide is driven by a shaft enclosed in the saddle, the change gears for determining the number of flutes being enclosed in a box with a hinged cover on the back of the headstock. When the lathe is reversed to return the tool to the starting position a slipping clutch comes into operation and the cam remains stationary.

Burton, Griffiths and Co., Ltd.

As agents and distributors for the products of the B.S.A. Tools Group and a number of other companies, Burton, Griffiths and Co., Ltd., Marston Green, Birmingham, has been able to arrange a very wide range of interesting machines, tools and equipment upon its stand. Several of these machines are shown in operation producing components under normal conditions.

Amongst the American equipment to be seen upon this stand is the "Simplimatic" automatic lathe made by the Gisholt Machine Company, of Wisconsin. This chucking machine has a platen table on which two or more independent slides can be mounted at any angle suitable to the class of work to be carried out. It has been made for many years and the machine exhibited incorporates a number of improvements to provide greater rigidity, simplicity of operation and production scope. The machine, illustrated in Fig. 10, is designed to swing work up to 33¼in over the bed or 22in over the table, the standard chuck sizes being 15in to 24in. Ten speed ranges are available from 16 r.p.m. to 321 r.p.m., with eight selections in each range.

Another American machine is a new design of single spindle bar automatic made by the National Acme Company, of Cleveland, which has five turret slides, two cross and one vertical slide, each actuated by independent cams. Indexing of the turret can take place without interrupting cross slide operations. The 3¼in machine shown has a standard spindle speed range of 120–1270 r.p.m. with a turret slide feed per spindle revolution of 0·001in to 0·0444in.

A bevel gear grinding machine made by the Maag Gear Wheel Company, Ltd., of Zurich, Switzerland, exhibited on this stand is shown on Plate 1. This machine is designed to grind straight and oblique bevel gears with involute tooth flanks up to a diameter of 16·5in at a ratio of 1 to 8 or work of smaller diameter at lower ratios. The working principle and design of the machine correspond essentially to the Maag gear grinders of same size for grinding cylindrical gears. It has two saucer-shaped grinding wheels of 8·7in diameter, which reciprocate along the tooth flanks in a straight-line motion.

The generating motion, which is obtained by means of pitch blocks, rolling discs and bands, comprises a rolling motion of the workpiece around its axis and a swivelling motion of the generating stand around the apex. The desired ratio of these motions is obtained by changing the diameter of one or both of the pitch blocks. The speed of the rolling motion (feed) of the generating stand around the apex can be infinitely varied from 22 deg. to 460 deg. per minute. Indexing takes place at both ends of the motion of the workpiece and is effected by means of change wheels and index plates, 13·5in diameter. The two slides carrying the grinding wheels are hydraulically driven and their speed can be varied infinitely from 0 to 50ft per minute.

Grinding is performed dry, the dust being removed by a suction unit built into the machine. An automatic counting and stopping device is fitted to stop the machine as soon as the preset number of teeth are ground. The standard range of accessories supplied include a special tip and root relieving attachment with an adjustable cam.

A companion machine to this gear grinder is the new Maag gear testing machine, shown in Fig. 11, which is designed to record the tooth alignment, thickness and profile and the surface finish of bevel gears up to 16·5in diameter. It is suitable for measuring the cone angle and the generating angle, as well as the lateral displacement in the case of oblique bevel gears.

The movements necessary for measuring on this machine correspond to those on the grinding machine described above, but are carried out by hand. As with the grinding machine, the generating motion of the bevel gears to be tested is obtained by means of rolling discs and steel bands. This motion consists of a rotation around the axis of the workpiece and a rolling motion around a vertical axis passing through the apex. The desired rolling ratio is obtained by altering the diameter of one or two rolling discs.

The recording device is carried on a movable horizontal slide, which is so designed that the points of contact of the feeler are on a line passing through the apex. The error magnification is adjustable between 400 : 1 and 1000 : 1. For checking the tooth alignment, no rolling motion is imparted to the workpiece, the fixing head remaining stationary. The feeler is moved along the tooth flank by turning a handwheel.

When checking a gear profile the slide carrying the feeler remains stationary. The fixing head is adjusted to the corresponding base cone when testing by means of a ball feeler or to the pitch cone when testing by means of a conical feeler. The generating support of the machine is rotated around a vertical axis, passing through the apex, by means of a handwheel. Gear profile errors are recorded on a graph paper.

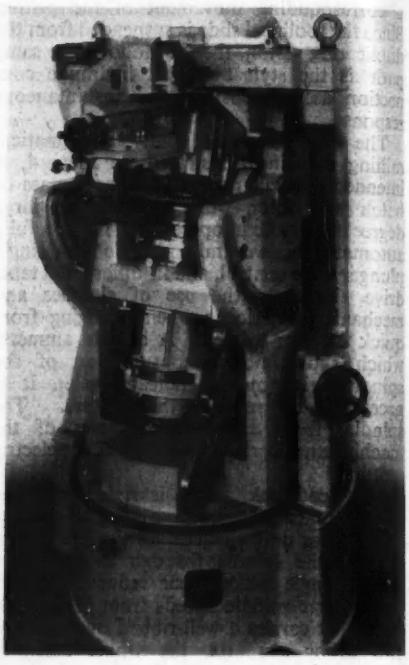


Fig. 11—Bevel Gear Testing Machine—Burton Griffiths

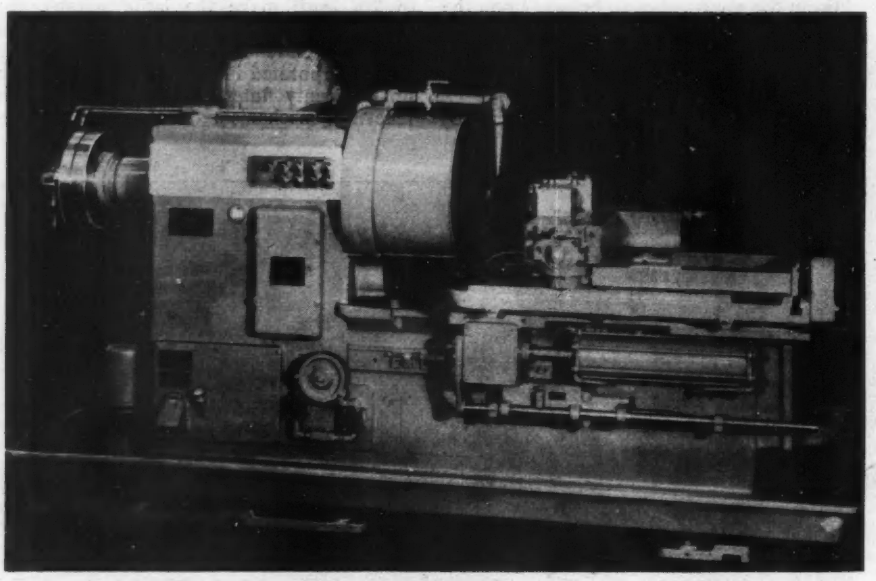


Fig. 10—Gisholt "Simplimatic" Lathe—Burton, Griffiths

Optical instruments are provided on the machine for reading the cone angle, the generating angle and the lateral displacement in case of oblique bevel gears. The instrument for reading the lateral displacement is removable and serves also for checking the generating angle of the fixing head of the machine. The accuracy of reading angles is stated to be two seconds, and that for the lateral displacement 0·0004in. Tooth thickness can be determined by contacting both flanks of a tooth with a special feeler and reading off the corresponding rolling angle.

The two thread rolling machines to be seen upon this stand are distributed for Leo. C. Steinle, Ltd. One of these machines is the B.S.A.-Steinle centreless thread generator and the other is a German "Pee-Wee" thread rolling machine. The B.S.A.-Steinle machine is similar to the one shown at the last Machine Tool Exhibition. In it the workpiece is subjected to hydraulic pressure whilst rotating between two cylindrical rolls or dies, and the rate of rolling can be closely controlled to suit the material. These machines can be used for serrating, straightening and burnishing as well as through-feed

rolling of threads to any length. With standard rolls the machine exhibited takes components from 2 B.A. to ¼in B.S.F. up to 2¾in long, another machine to the same design rolls threads from ⅜in Whit. to 3in diameter by four threads per inch.

The "Pee-Wee" thread and form generator is illustrated in Fig. 12. In it forms are produced by centreless cold rolling under hydraulic pressure, and it can be used as a universal machine or as a single-purpose mass production machine when fitted with a magazine feeding attachment. In addition to being suitable for forming practically all kinds of threads, it can be used for profile rolling, serrating, burnishing or gear toothing. Work from $\frac{5}{16}$in to 3in can be accommodated in the machine and threads from thirty to five threads per inch can be rolled. Drive is transmitted through a P.I.V. gearing and the speed of rolling is infinitely variable. Rate of roll infeed and pressure are controlled through hydraulic valves on the control panel.

Ward, Haggas and Smith, Ltd.

The largest of the three lathes upon the stand of Ward, Haggas and Smith, Ltd., of Keighley, is the 5ft diameter swing surfacing and boring machine, illustrated in Plate 2. The rigid bed of this machine is long enough to admit work up to 3ft. between the face-plate and cross slide.

The machine has an all-geared headstock of heavy design which is driven through vee belts from a 15 h.p. motor and gives eighteen spindle speeds from 2·5 r.p.m. to 60 r.p.m. The hard steel ground spindle runs in phosphor-bronze bearings, which are adjustable for wear, and the end thrust is taken on a heavy ball thrust washer. It has an integral flange carrying a 4ft 6in diameter face-plate.

The cross slide is adjustable along the bed by power and carries two sets of compound slides, each arranged with self-acting feeds in all directions. Six sliding feeds from eight to sixty cuts per inch are available in these slides, and they are indexed for taper turning purposes. A reverse is incorporated in the feed box and a safety clutch on the feed shaft prevents damage to the gearing in the event of overloading.

A 24in and a 36in openside planer shapers, which are also upon this stand, are of a straightforward design incorporating simplicity of operation with accuracy and rigidity, as can be seen from the photograph reproduced in Fig. 13. These machines have a rigid bed carrying the table on accurately scraped vees and any tendency towards table lift during working is prevented by jibs fastened underneath. The table stroke is imparted by a crank motion, which gives a quick return, and there are six speeds from eight to seventy strokes per minute.

A column bolted to the bed has wide bearing surfaces for the balanced cross slide which carries a swivelling head with a horizontal tool travel of 22in. Hand and power cross and vertical feeds are provided in each direction.

B.S.A. Tools, Ltd.

Prominent amongst the exhibits on the stand of Burton, Griffiths and Co., Ltd., are representative machines from the wide range of automatics made by B.S.A. Tools, Ltd., of Birmingham. These automatics include a group of B.S.A. Acme-Gridley multi-spindle machines of which one of the 2¾in six-spindle bar units is to be seen on Plate 3.

The frames of these machines are built up from four main castings—pan, headstock, gearbox, and top rail—and all the mechanism is totally enclosed. The spindle carrier is carried on heavy bearings with provision for taking up wear, and the end toolslide is supported by bushes in the carrier and a heavy guide arm below the carrier. A positive stop controls the slide travel for depth drilling, reaming and length of turning, &c. Each of the two main cross slides is firmly supported on large ways so that heavy forming cuts can be made at high speeds without causing vibration or chatter. A cam drum beneath each of these slides gives powerful and direct movement, and an independent stop on each slide is arranged to engage an adjustable stop on the periphery of the spindle carrier.

The two cross slides carried by the top rail are operated through a lever and quadrant from the cams on drums under the main cross slides. In the 2¾in machine illustrated the two top slide drums are mounted in the top rail. The chucking and feeding slides are mounted on two large-diameter shafts supported between the headstock and an arch, and cams for operating the chucking and feeding mechanism are conveniently arranged on a drum under the slides.

A motor on an adjustable platform over the headstock drives the machine through vee belts, and pick-off gears used to effect speed and feed changes are situated at the drive end of the machine. Changes from approach traverse to cutting traverse speeds is effected through cone and plate clutches which actuate a cam and work in conjunction with a brake.

A 5¼in six-spindle B.S.A. Acme-Gridley automatic chucking machine, also illustrated on Plate 3, is a recent addition to the range manufactured in this country under licence. It turns work up to 4in long and has a range of spindle speeds from 172 r.p.m. to 1492 r.p.m. This machine has manually controlled, hydraulically operated chucks, and a fully automatic hydraulic unit operates the spindle clutch and brake. Work is changed at the loading station whilst the tools in all the other stations continue working, the only non-productive time being that for indexing of the spindle carrier and moving the tools in respect to the work.

The main tool slide is mounted directly on the spindle carrier and on it a combination of tools, such as for turning and high-speed drilling in one position is easily arranged.

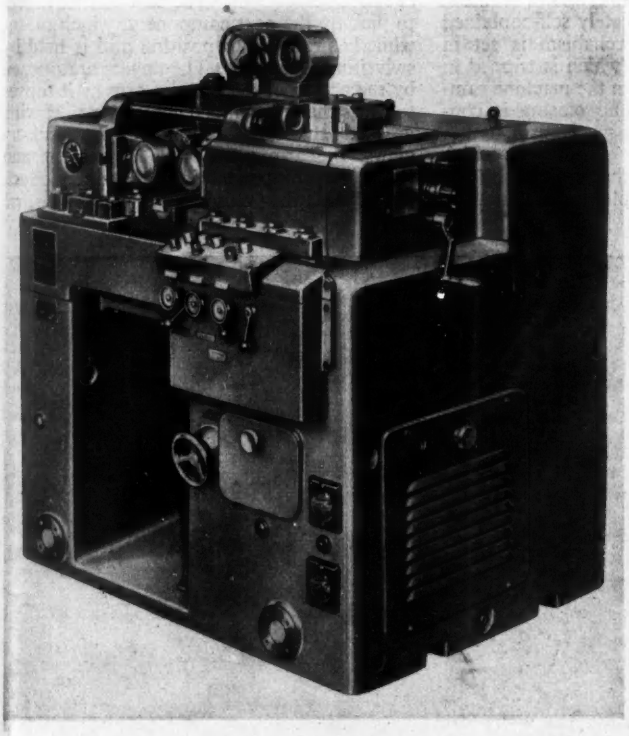


Fig. 12—Thread and Form Generator—Burton, Griffiths

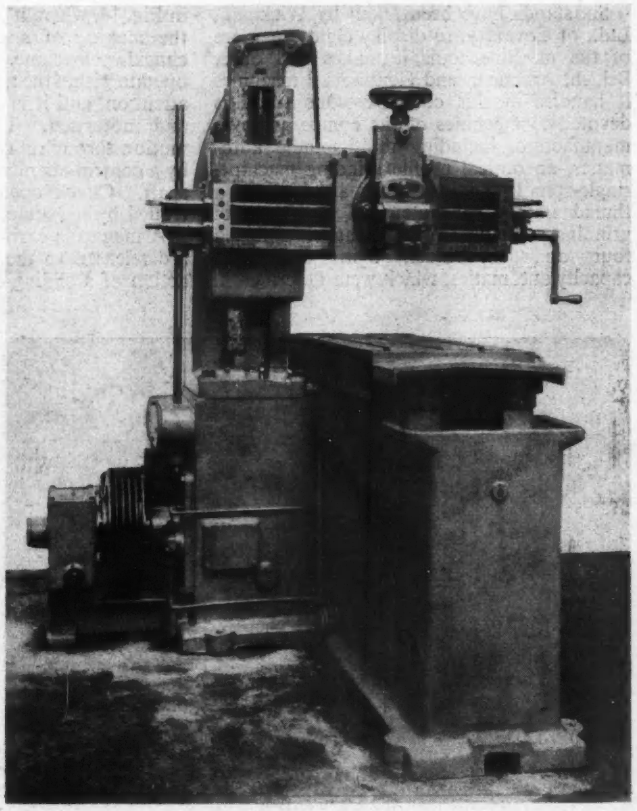


Fig. 13—Openside Planer-Shaper—Ward Haggas and Smith

A variable fine end adjustment to the tool slide in relation to the chucks simplifies setting when components of different lengths have to be machined, as it obviates the necessity to move individual tool holders at various stations. Each of the four heavily built cross slides is fitted with a positive adjustable stop which engages a hardened adjustable stop on the spindle carrier.

The B.S.A. " L " type single-spindle automatic introduced by the firm about a year ago was described in our issue of June 1, 1951. These machines are made in two sizes with 1in and 1⅛in diameter maximum capacity with long and short-stroke turrets, and a 2in capacity with a long-stroke turret only.

The machines have a wide range of speeds and ratios in both directions, spindle drive being transmitted from the gearbox through two cone clutches and duplex roller chains. A totally enclosed backshaft is driven at a constant speed by a belt from the main drive shaft, engagement being through a lever-operated clutch. Tripping of the various clutches is effected by push rods passing through the body of the machine. The cross slideways are of ample proportions, and adjustment is provided for setting forwards or backwards relative to the spindle. A vertical slide can be fitted when required, and all three slides are operated by cams.

The cross slides, stock feed, spindle speed change and reversal and turret cam drives are all controlled by the front and turret camshafts. These mechanisms are easily accessible through hinged covers and they are driven from the backshaft through a worm drive and pick-off gears, providing 106 different cycle times which are entirely independent of spindle speeds.

The turret has six tool stations, and its slide feed is actuated by a cam-operated quadrant and rack. Smooth and rapid turret indexing is given by a link and Geneva motion indexing mechanism.

Wickman, Ltd.

Six stands have been taken by Wickman, Ltd., of Coventry, to display eighty or more of the machine tools it makes and other British, American and Continental machines it handles in this country. One stand is devoted to machines of the company's own manufacture, including multi-spindle automatics, an optical profile grinding machine, single-spindle sliding head automatics, a thread milling machine, and carbide tool grinding machines. The recently introduced four and six-spindle, 3½in and 2⅝in capacity automatics, which were described in THE ENGINEER, September 29, 1950, are to be seen, together with a new 1¾in bar capacity eight-spindle machine.

This new automatic (see Plate 3) can be arranged as a conventional machine or as a double indexing machine with bar feeding in two stations, and it is demonstrated producing two dissimilar components at each cycle. The leading particulars of the machine are as follows :—

Maximum bar diameter	1¾in
Standard bar feed	0–5in
Long bar feed (special cam required)	5–10in
Feed stroke on main tool block	0–5in
Feed stroke on fifth and sixth independent slides	0–5¼in
Standard idle stroke to end working slides	3¼in
Special idle stroke to end working slides	5in
Maximum length turned with standard idle stroke cam	9in
Idle stroke on lower cross slides	1¾in min.
Feed stroke on lower cross slides	0–1¾in
Idle stroke on upper cross slides	1¼in
Feed stroke on upper cross slides	0–2¼in
Idle stroke on auxiliary cross slides	1¼in
Feed stroke on auxiliary cross slides	0–1¼in
Spindle speed range in twenty-four steps	96–1243 r.p.m.
Range of cycle times in seconds	8–922
Motor (maximum horsepower and speed)	40 at 1425 r.p.m.

Although of smaller bar capacity the new machine is built in the same frame size as the larger machines and, like all Wickman multi-spindle automatics, it incorporates auto-setting mechanisms, by which alterations to tool feed strokes and bar feed can be made without cam changing.

A total of eighteen tooling faces are available ; eight on the main tool block, two on independent slides in stations 5 and 6, four on cross slides, and four on two double-station auxiliary cross slides. The independent longitudinal slides and the rear auxiliary cross slide are optional cross equipment. Alternative types of auxiliary cross slides are also available to suit particular applications.

All cross slides are fitted with micrometer adjusting screws, and master stops engaging stop screws in the spindle drum stop ring allow small sizing errors to be cancelled out. Standard tool holders and attachments are interchangeable between stations and between machines.

An interesting pick-up and loading attachment for automatics to be seen is illustrated in Fig. 14, where it is used in connection with the making of a cast iron flywheel on a chucking machine. This unit is timed to operate within the machine cycle time without attention, and it is completely self-contained and motorised. The mechanism is set in motion through a clutch which is tripped in by a control operated from the machine camshaft. Chuck opening and closing is controlled by the attachment mechanism.

A magazine carries the components which are released to the loading position by the action of a sliding cam plate *A* actuated by the movements of the pick-up arm. Fig. 14 shows the pick-up arm halfway through its cycle, having picked up a machined component from the fifth and last station and moved in a direction away from the chuck jaws. This is followed by a radial movement carrying the component to the pick-up position as illustrated.

A further movement of the arm away from the attachment brings push rods *B* in contact

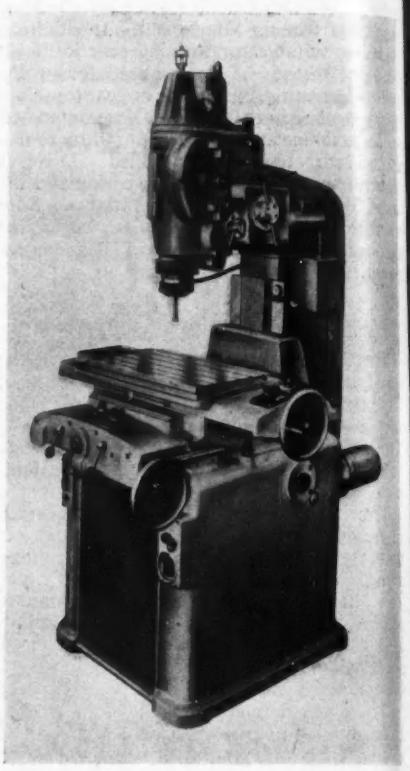
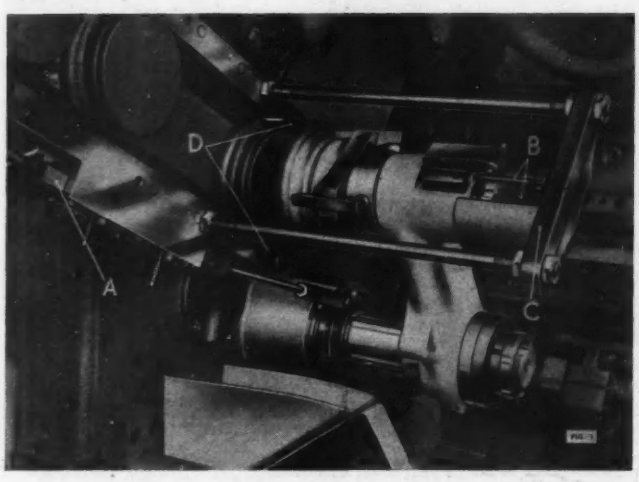
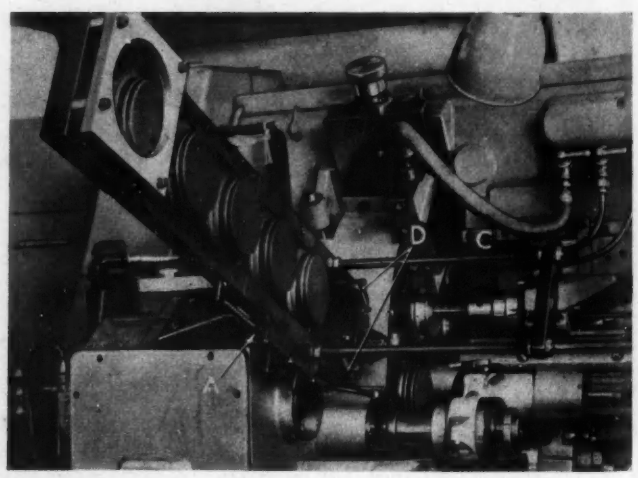


Fig. 16—Hauser Jig Grinder—Wickman

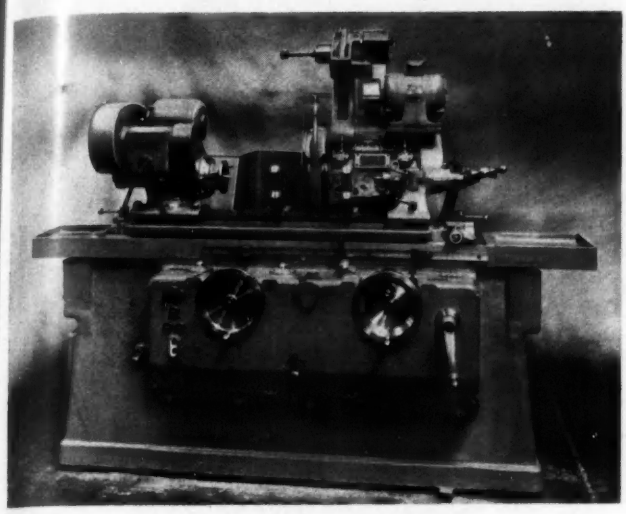
with a stop *C* to open the pick-up claws and strip the component. The arm then advances to pick up the next component, which meanwhile has rolled into position and is held by swivelling fingers *D*. The fingers are opened by the action of the pick-up arm as it moves towards the unmachined component. Having grasped the new casting in the pick-up claws, the arm retraces its movement and loads the component into the open chuck jaws, which then close (see Fig. 15). The arm



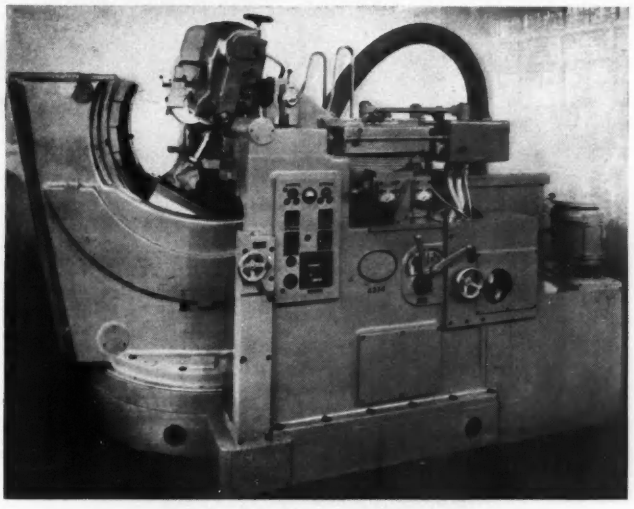


Figs. 14 and 15—Automatic Pick-Up Loading Attachment—Wickman

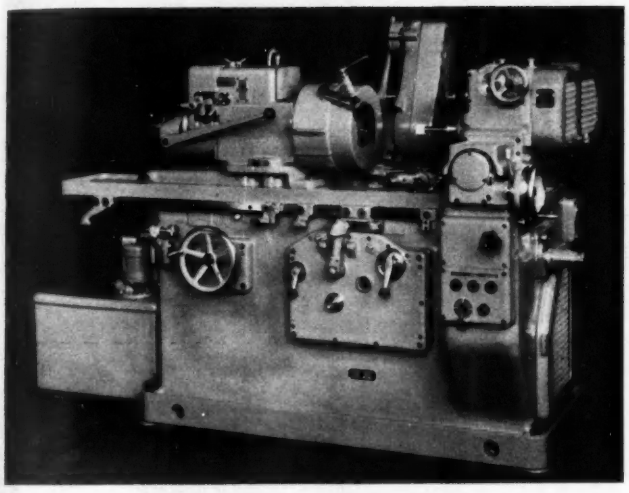
GRINDING MACHINES AT OLYMPIA



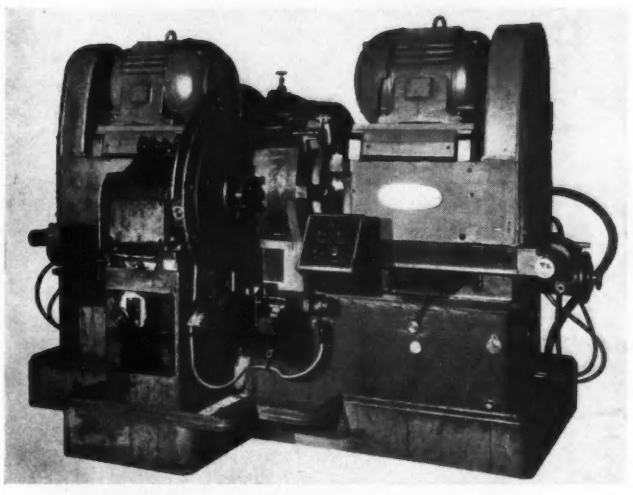
Universal Grinding Machine—Churchill



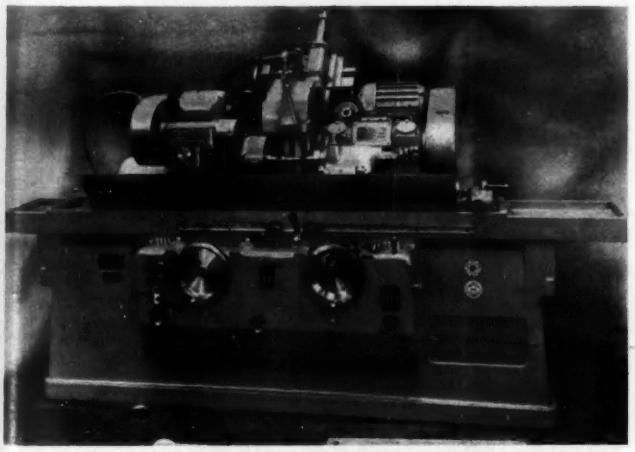
Maag Bevel Gear Grinding Machine—Burton Griffiths



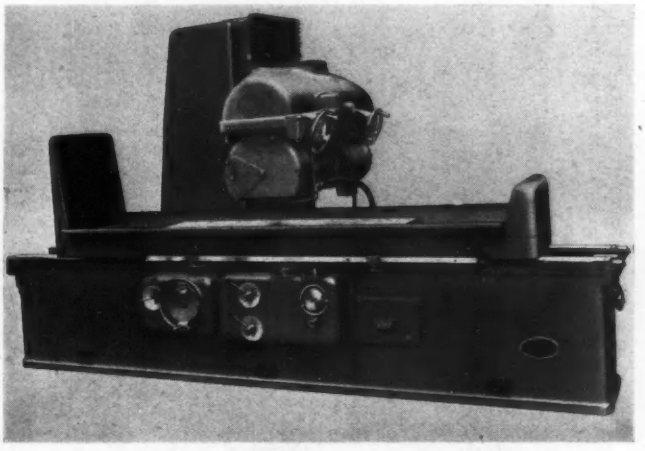
Jung Internal Grinding Machine—Rockwell



Duplex Surface Grinder with Rotary Feed Carrier—Rowland

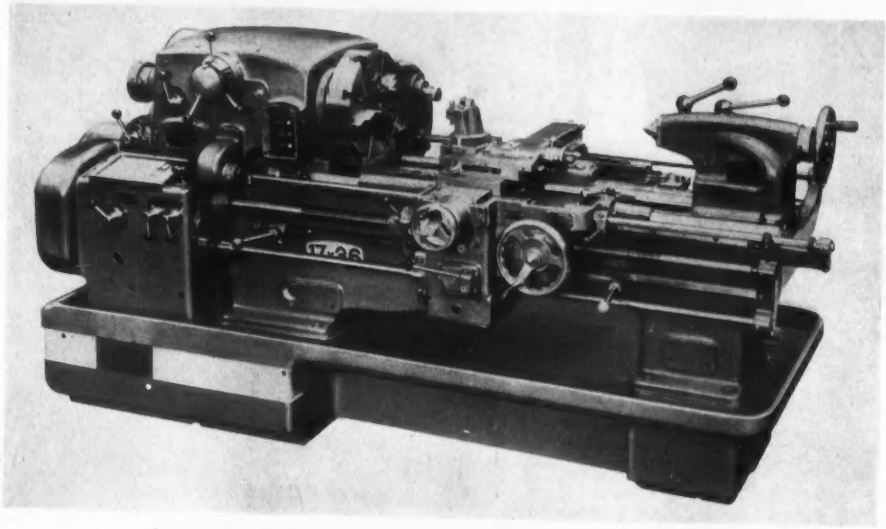


Automatic Sizing Plain Grinding Machine—Churchill

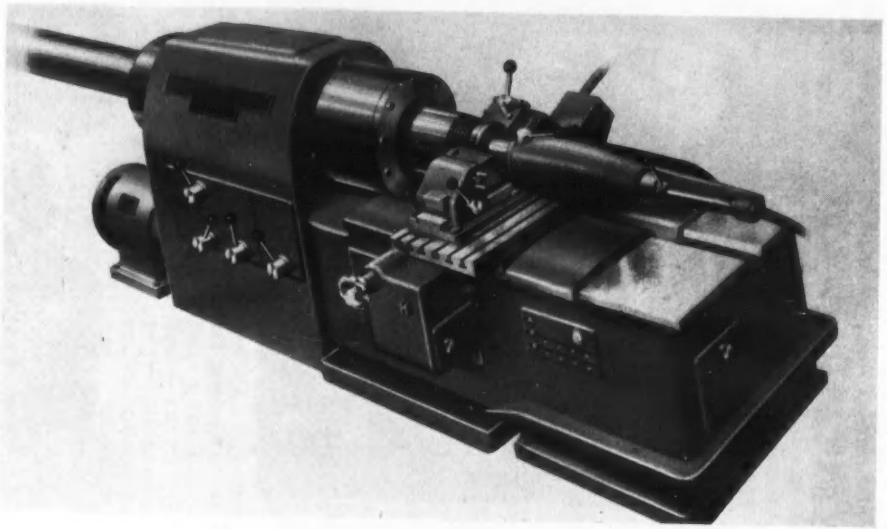


Heavy Duty Precision Surface Grinding Machine—Snow

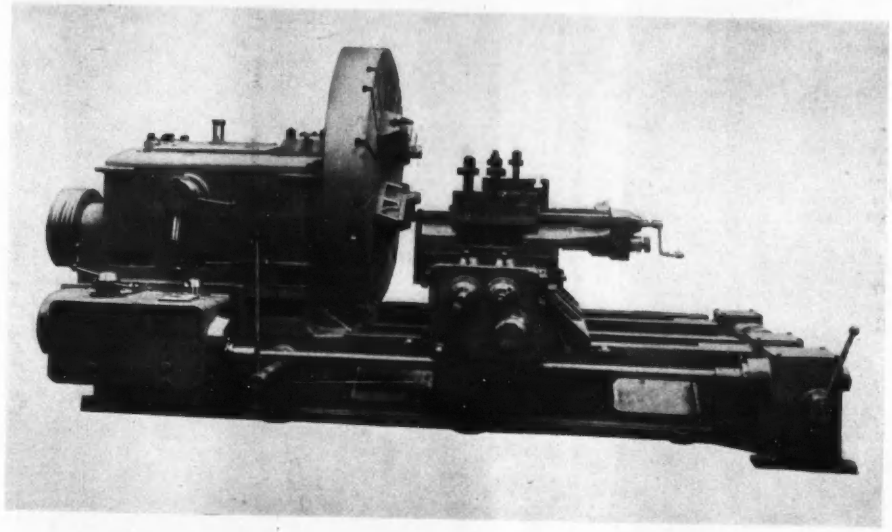
LATHES AT OLYMPIA



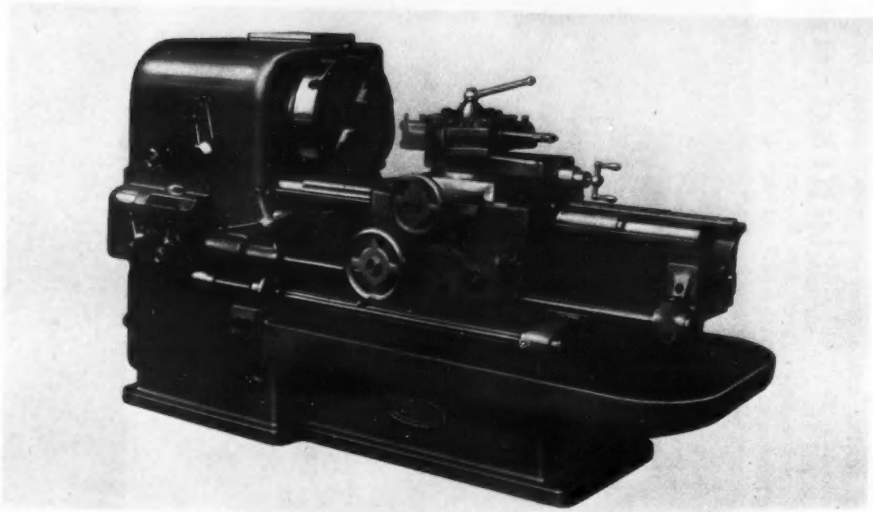
Toolroom Lathe—Dean, Smith and Grace



Tube Threading Lathe—Sentinel



Surfacing and Boring Lathe—Ward, Haggas and Smith

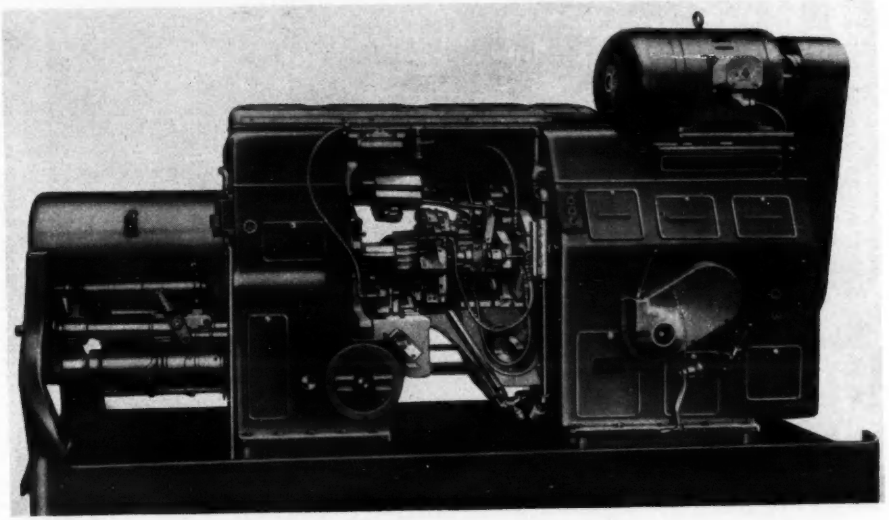


"Junior" Lathe—Lang

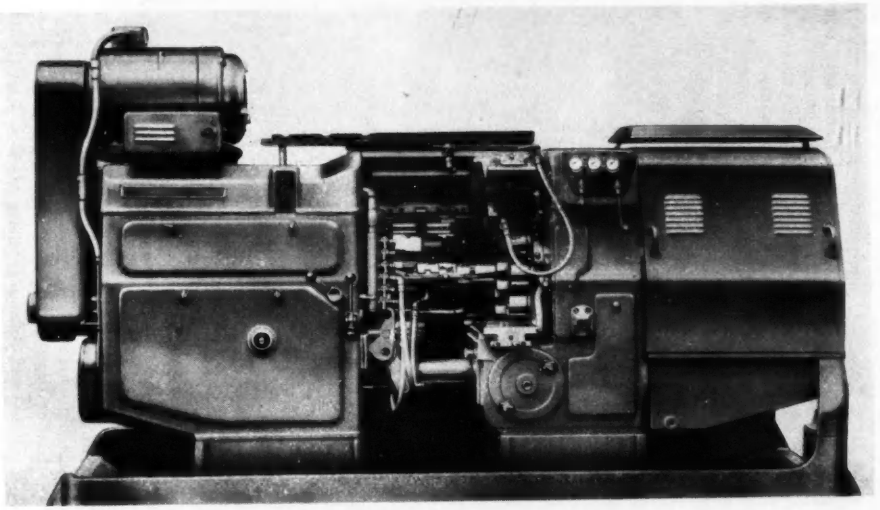
Surfacing and Boring Lathe—Ward, Haggas and Smith

"Junior" Lathe—Lang

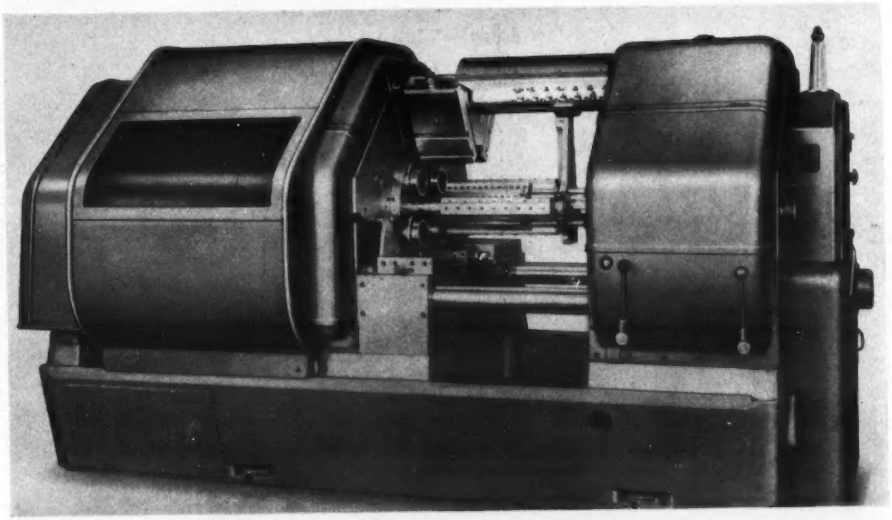
AUTOMATICS AT OLYMPIA



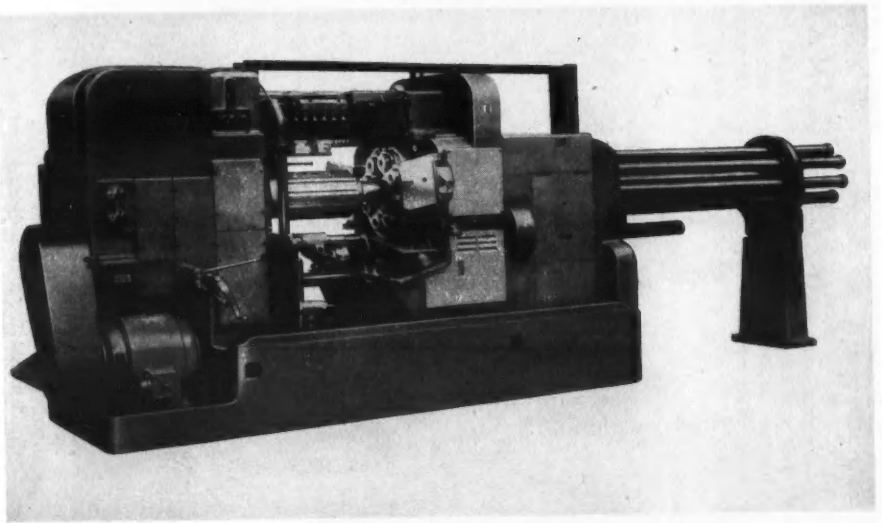
2⅝in Six-Spindle Bar Automatic—B.S.A.



5¼in Six-Spindle Automatic—B.S.A.

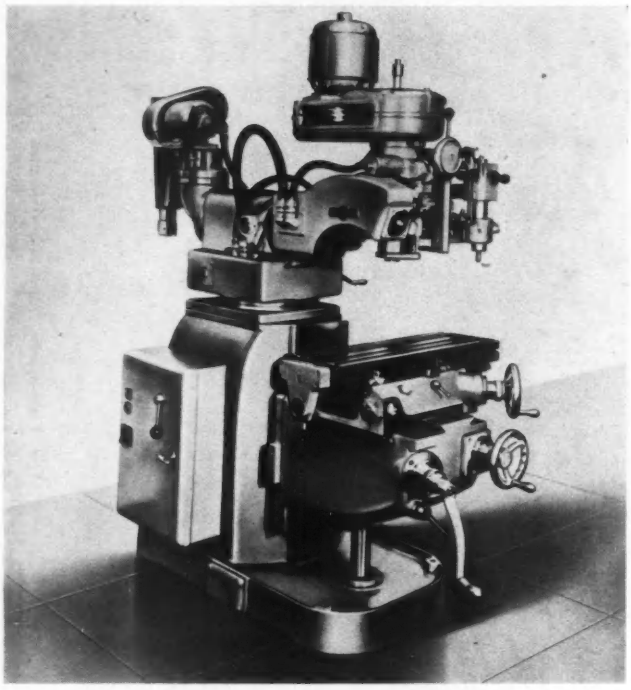


Schutte Four-Spindle Automatic—Rockwell

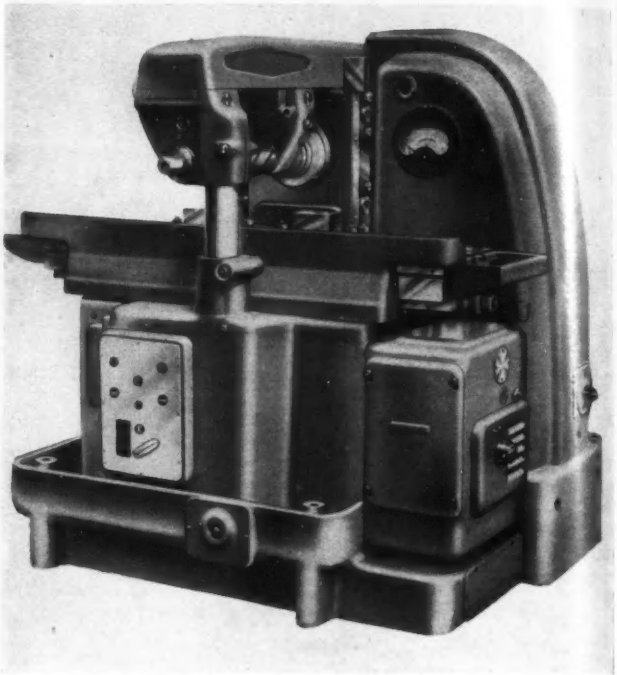


1⅜in Eight-Spindle Automatic—Wickman

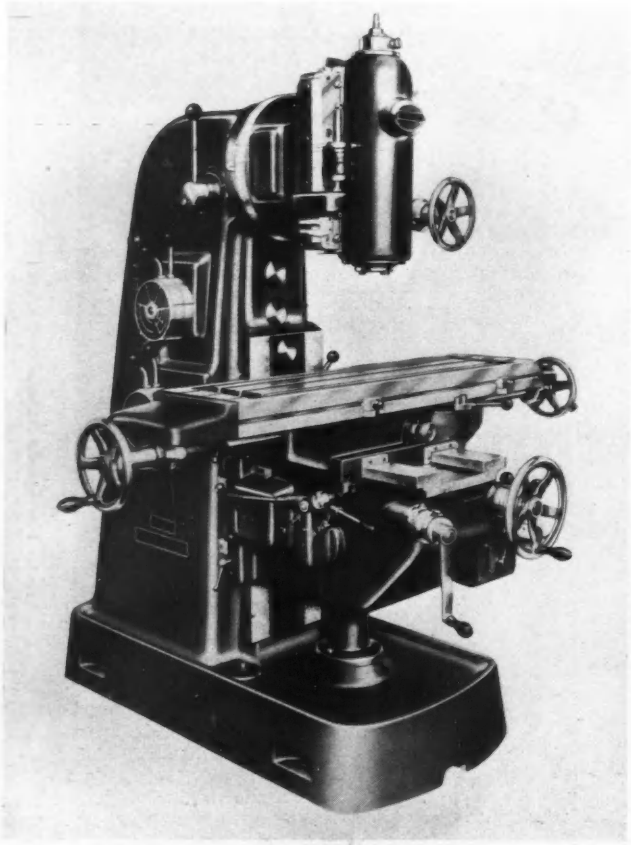
MILLING MACHINES AT OLYMPIA



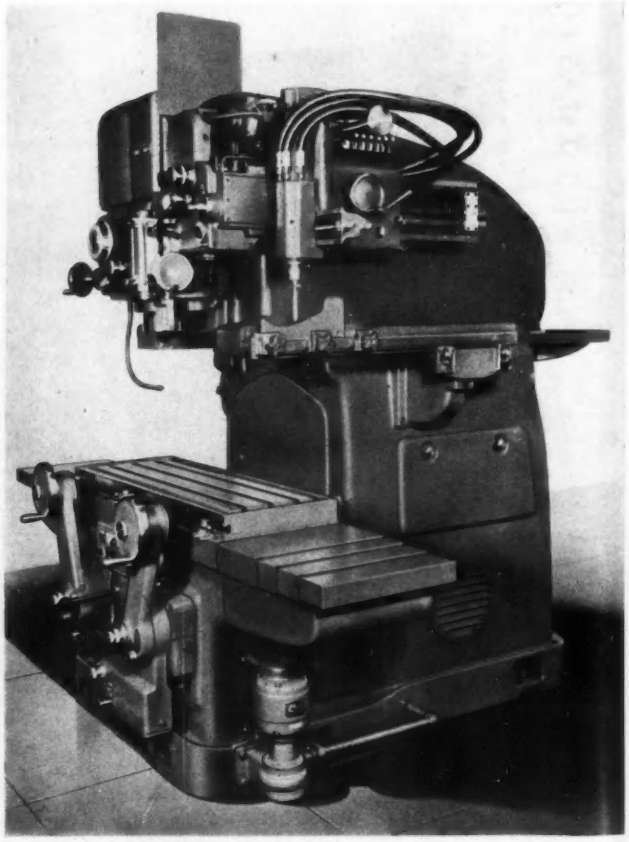
Tool and Die Miller—Cincinnati



Automatic Milling Machine—Rockwell



"Riva" Vertical Milling Machine—Ward



Vertical Hydraulic Milling Machine—Cincinnati

then withdraws while indexing takes place, advances again when the next machined component is indexed, and the cycle continues.

The Swiss-built equipment on the stand includes a new and larger capacity model of the jig grinding machine made by Henri Hauser, Ltd., of Bienne. This new machine (Fig. 16) has a grinding capacity of 3⅝in diameter. Its interchangeable spindle unit is driven by compressed air and by adjustment of air line pressure has a range of speeds up to 50,000 r.p.m. with standard and 75,000 r.p.m. with special spindles.

The spindle unit has an adjustable planetary motion within a reciprocating sleeve, the stroke being steplessly variable from 0 to 3$\frac{3}{16}$in, to suit the length of hole being ground. Setting of the planetary motion to apply the cut is effected by hand, the amount of feed, up to a maximum of $^{5}/_{64}$in on diameter, being indicated on a dial gauge mounted in a convenient position on the machine head. Provision is made for grinding taper holes with included angles up to 3 deg. on a length of 2$\frac{3}{16}$in.

The spindle head assembly has means of vertical power adjustment through a ½ h.p. motor, the maximum setting distance from table to spindle nose being 22in. A scale on the vertical guideway, in conjunction with a dial gauge reading to 0·001in, facilitates the accurate grinding of blind holes to depth.

The work table has a longitudinal travel of 16in and a transverse travel of 10in. Co-ordinate settings are made by means of precision, ground thread lead screws fitted with pitch correction devices, and the dividing drums and verniers, which read to 0·0001in, are protected by glass windows and are electrically illuminated.

One of the three high-speed shaping machines made by Klopp Werke G.m.b.H., is of traversing head design, and is illustrated in Fig. 17. In this machine the ram carriage is a completely independent unit, which traverses along the ways on the top of a heavy cast base, and the work table can be set and locked at any required position along the front of the base.

The independent ram carriage incorporates a hydraulic drive mechanism, through which all movements are controlled, and in it are mounted the controls for the feed drive, rapid traverse and hand feed. The ram is driven directly by a hydraulic cylinder and has an infinitely variable stroke up to 39½in, with speeds from 26ft to 72ft per minute for roughing and 72ft to 105ft per minute for finishing. Its automatic cross feed is adjustable from 0·008in to 0·079in over a shaping width of about 39½in, the maximum possible shaping width being 59in.

The 39½in by 20½in table has a vertical movement of 18¾in, whilst the vertical movement of the cutter head is 8¼in. When it is required to do vertical shaping the ram carriage is locked to the ways of the base and at the same time the feed and traverse mechanisms are locked to prevent conflicting feed motions.

One of the two Naxos-Union grinding machines on the stand is an example of one arrangement of the Series R300 machines made by that company. In this series of machines various unit mechanisms can be arranged in different combinations for a wide variety of production grinding applications. The basic plain grinder with various modifications and additions can be supplied as a plunge grinder, a camshaft grinder, a general purpose grinder—with and without a swivelling head—and a universal grinder.

Cincinnati Milling Machines, Ltd.

A group of some sixteen machines has been selected by Cincinnati Milling Machines, Ltd., of Woodlands Farm Road, Birmingham, 24, to give a general impression of the range and variety of equipment it makes, with some of the latest points in design.

The group of four production milling machines includes three of the firm's "Hydromatic" machines, which incorporate a form of unit construction designed to permit a wide grouping of variable factors. One of these machines, a "3–36" plain tracer-controlled unit, is illustrated in Fig. 18. It has a sensitive tracer-controlled movement of the spindle carrier, which synchronises its vertical movements with the longitudinal travel of the table for the reproduction of profile shapes from master templates.

These "Hydromatic" machines consist essentially of a heavy fixed bed carrying a sliding table, and to which can be fitted a right-hand or left-hand headstock or column on which a spindle carrier slides vertically. Plain machines have the basic bed unit with a right-hand headstock and spindle carrier, as shown, and duplex machines have a right-hand and a left-hand headstocks arranged one on each side of the bed.

The spindle carriers are moved vertically on the headstocks by hydraulic means under control of a tracer valve, and cross adjustment of the cutter is effected through a large close-fitting quill. Drive from the motor in the base of the headstock is transmitted through a clutch, reverse gearbox and constant-speed splined shaft. In the machine exhibited the eight-spindle speeds available range from 37 to 276 r.p.m. The hydraulically operated table has an infinitely variable range of feeds from zero to 40in per minute and the vertical movements of the spindle carrier are synchronised with the automatic table cycles to ensure that it will always be raised or retracted before the table can move at the rapid traverse speed. The automatic hydraulic tracer unit is arranged on the headstock, and a roller at the end of its tracer mechanism is arranged to follow the profile of a master template bolted to the work fixture to raise or lower the spindle carrier according to the contour required.

It will be appreciated that machines of this type can be specially designed and built to meet the requirements of particular milling operations on components such as cylinder blocks and heads, transmission housings, &c. They vary widely in form and to show one special design, one known as "ram type" is exhibited. This is a special four-spindle duplex machine arranged for rough and finish milling the ends of cylinder blocks at one setting. A feed rate of 50in a minute is employed, with stock removal of ¼in for roughing and $^{1}/_{30}$in for the finishing cut. The machine is intended to be located astride a conveyor line, so that components are loaded at the front, then passed between the cutters, to be unloaded at the rear on to the conveyor.

This firm's vertical "Hydro-Tel" milling machine is built in three types. The basic machine is provided with hand and hydraulic power feeds to the table and cross slide, and hand feed only to the vertical spindle carrier. When it is arranged as a die-sinking machine with automatic depth control as in the machine exhibited, and illustrated on Plate 4, automatic sensitive tracing is provided in a vertical plane under the control of a template or master shape. It can also be supplied with an automatic hydraulic 360 deg. profiling mechanism for profiling work only and operating in both the vertical and horizontal planes. In this case the table and cross slide movements are controlled entirely by the profiling mechanism. An automatic cycle attachment enables full form impressions to be machined without constant attention from the operator.

The machine is fitted with a table having a working surface of 16in by 53in and a travel of 30in. Its cross range is 16in and the spindle nose can be set between 12in to 22in from the top of the table. An infinite range

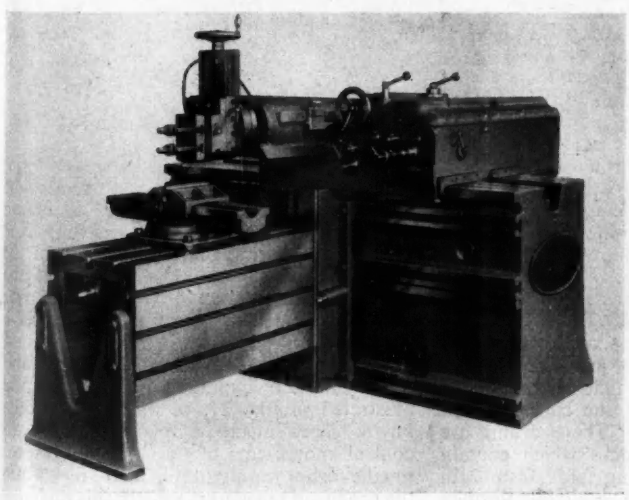


Fig. 17—Klopp Hydraulic Traversing Head Shaper—Wickman

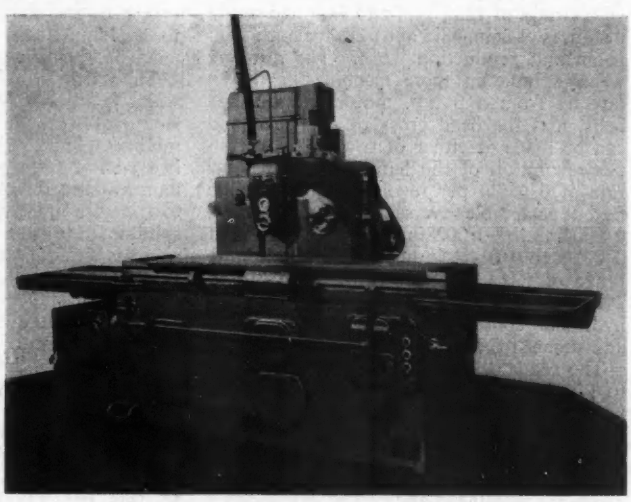


Fig. 18—"Hydromatic" Milling Machine—Cincinnati

of table and cross slide feeds from 1in to 25in per minute, and sixteen spindle speeds from 25 to 1500 r.p.m. are available on the standard machine.

Another very useful toolroom machine is the 8in. by 18in tool and die miller, also shown on Plate 4, which is designed for the rapid and accurate production of moulds and dies. It has a high degree of versatility and a number of secondary operations, such as drilling, boring, slotting, &c., can be performed at one setting within the working area of 8in by 18in. A hydraulic automatic depth control tracer unit on these machines synchronises vertical movements of the cutter with movements of the table and saddle to duplicate the contours of master shapes.

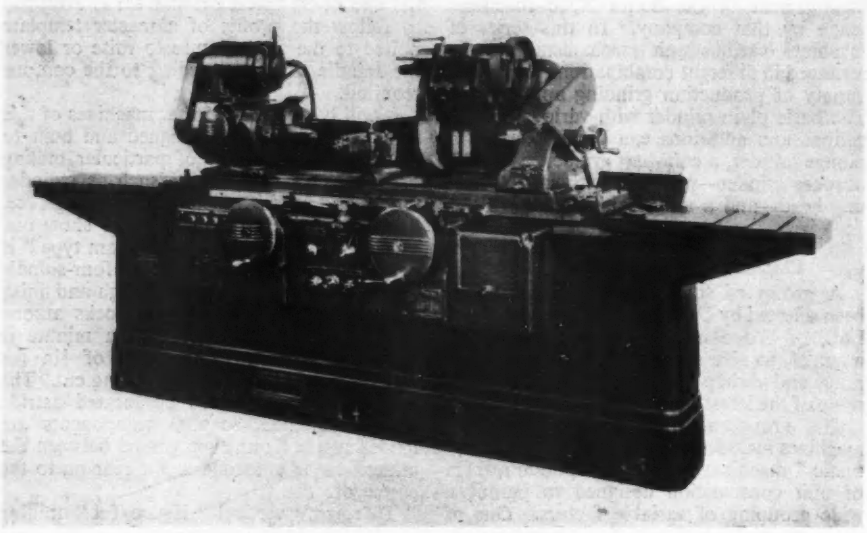


Fig. 19—Universal Grinding Machine—Cincinnati

The spindle carrier unit can be swivelled in each direction over a useful range to make possible a wide variety of angular cuts. It is carried on a ram slide on the base of the machine, and by using this slide the cross range can be extended to cover work up to 14in wide. The ram slide complete with the spindle carrier can be swung through 180 deg. on the base and, if required, a slotting attachment can be fitted to the rear of the ram, as shown in the illustration.

In Fig. 19 we reproduce a photograph of one of the hydraulic universal grinding machines, which are made in different models with swings of 12in, 14in and 18in and centre distances of 36in, 48in and 72in for both toolroom and production work. The grinding wheel spindle in these machines is driven directly from a 3 h.p. motor through vee belts, and the head cross traverse by hand can be made at either of two speeds of $\frac{1}{4}$in per revolution of the handwheel or a slow rate of 0·050in per revolution. Automatic feed at each table reversal can be varied from 0·0004in to 0·0028in in low gear and 0·002in to 0·014in in high gear. An infinite range of table traverse speeds from 3in to 240in per minute is obtainable through the hydraulic control gear and a table dwell adjustment from 0 to 5 seconds can be set.

The headstock, which can be swivelled up to 90 deg. one way and 30 deg. the other, has an infinitely variable range of spindle speeds from 55 to 500 r.p.m. and is driven through vee belts by a $\frac{3}{4}$ h.p. motor. An internal grinding attachment is arranged above the wheelhead and can be swung down into position when required. Its spindle is driven at 15,000 r.p.m. and a range of interchangeable quills available cover holes from $\frac{5}{16}$in to $1\frac{1}{2}$in minimum diameter and 3in deep.

A new duplex ram vertical broaching machine shown in operation on the stand is arranged to demonstrate the high rates of production obtainable with surface broaching. It is tooled up for broaching bearing caps. It progressively rough broaches the joint face, broaches the bolt bosses, and finish broaches the joint face, tenon width and chamfer. The bearing caps are held in quick-acting clamping fixtures mounted on the receding tables of the machine, one fixture being reloaded whilst the other is in the cutting position.

The machine exhibited is designed to take broaches up to 62in long and its normal broaching force is 20,000 lb. Its forward and return ram speeds are the same and are infinitely variable between 9in and 22in per minute.

John Holroyd and Co., Ltd.

An automatic ending and centring machine particularly designed for preparing blanks for turning on automatic copying lathes has been developed by John Holroyd and Co., Ltd., Milnrow, Lancs, and is shown in operation at Olympia. Machines of this design take blanks up to 5in diameter and from 10in to 8ft long, and both ends of the work are machined at the same time.

The machine has two headstocks, one of which is adjustable along the bed to suit the length of work. In each of these heads a milling spindle rotating on roller bearings is driven at 160 r.p.m. through gearing by a flange-mounted motor. A flywheel is fitted to the nose and the single speed provided is suitable for tungsten carbide cutters. Drilling spindles fitted in the centre of the milling spindles have collet chucks to take centre drills up to $\frac{5}{8}$in, and means are provided for adjusting the depth drilled. The drill spindles have a set speed of 500 r.p.m.

The cutter spindles are eccentrically mounted on drums so that the action of rotating the drum feeds the cutters across the ends of the work. These drums are mounted in the headstocks which contain the feed gearing. Milling feeds from $2\frac{1}{2}$in to 14in per minute are available through pick-off gears in the rotary feed of the drum.

The work vices clamped on the bed of the machine are automatic and self-centring in operation, the closing and opening being controlled through a push button.

When the automatic milling and centring operations are set in motion by depression of a push button, each drum rotates quickly until the cutter is just clear of the work, and then trips into the milling feed. On completion of the milling, the drum trips into quick rotation and then traverses until the drilling spindle is central with the work. The quick rotation and milling feed positions are controlled by trip dogs which are set to suit the diameter of work. When the drum has reached the central position, which is controlled by a dead stop, the rotary feed motor cuts out and the cam feed to the drill starts. On completion of drilling, the drum returns quickly to its initial position.

Soag Machine Tools, Ltd.

A number of the machines of Continental manufacture which appear on the stand of Soag Machine Tools, Ltd., Juxon Street, London, S.E.11, are being shown for the first time in this country.

One of the heavier machines exhibited is the heavy-duty high-speed Berthiez vertical boring mill, illustrated in Fig. 20. This machine has a 40in diameter table, designed to swing work up to $44\frac{1}{2}$in when fitted with a side head and 57in without the head. The table is driven by a 34 h.p. motor giving through gearing a range of eighteen speeds from 5 to 250 r.p.m. As will be seen from the photograph, the arm of this machine in addition to being supported on slides on the front of the upright, is further supported by a buttress forming an integral part of the arm and sliding on ways at the side of the upright. This full support of the arm over its full movement on the upright imparts a high degree of rigidity for heavy work.

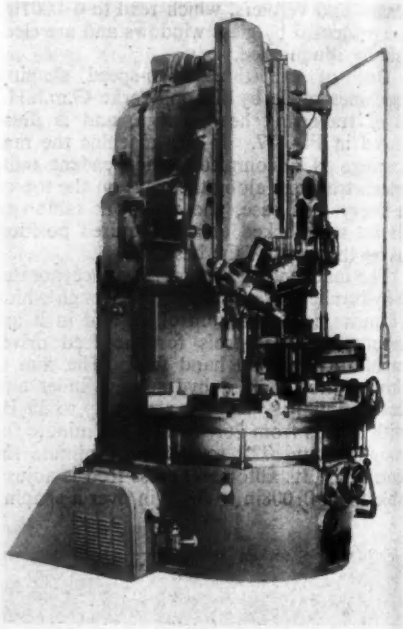


Fig. 20—Berthiez Boring Mill—Soag

An interesting little machine on this stand is the Bartsch hydraulic copying shaper, illustrated in Fig. 21, in which the profile on a sheet metal template is used to control movements of the table in respect to the reciprocating tool, and reproduce the profile on the workpiece. In this machine the cylindrical ram and guide slide in pre-

ision adjustable taper bushes and are ydraulically operated over a variable work-ng stroke of up to 8in. The tool head can e swung up to 45 deg. on each side and has n adjustment of 2⅜in. An infinitely variable ange of cutting speeds up to 65ft per minute s available.

Work can be mounted directly on the

Fig. 21—Bartsch Copying Shaper—Soag

tiltable table or in fixtures or a quick-acting vice. This table has a transverse adjustment of 8⅝in and a vertical adjustment of 6in, and during working its movements are hydraulically controlled. The hydraulic tracer unit is mounted on the left-hand side of the table ways whilst the template is carried on a bracket extending from the side of the table itself. As the table is fed along under the tool the hydraulic cylinder controlling its vertical movement is actuated through the tracer unit in accordance with the profile of the template. By using a special centre attachment it is possible to machine the entire circumference of a workpiece.

The Kunz universal sheet metal working machine (Fig. 23) is designed to operate with a wide range of units to adapt it for flanging, upsetting, drawing, smoothing, roll bending, strip shearing, curve shearing, nibbling, &c. It has a gap 31½in deep and its arms on which the units are fixed are 15in apart. The operating head is driven through a shaft and change-speed gearbox by a motor at the rear of the machine. As a matter of interest some notes on some of the tools which can be used with this versatile machine should be given. It should be pointed out that a large range of tool adjustment is given through the spindle and handwheel at the end of the lower arm of the machine. The upsetting unit has eccentrically operated upsetting cheeks with adjustable stroke. The drawing and smoothing unit consists of an adjustable flying top roll and changeable bottom roll, and full-size beading tools can be fitted into this unit when required.

The strip shearing unit cuts a narrow strip out of the sheet with a toothed top blade against two inclined bottom blades, and the circular shearing unit is fitted with an adjustable eccentric disc for different sheet thicknesses. Its bottom blade can be adjusted for outside and inside cuts without preliminary punching. Beading, flanging and vent slitting tools can be mounted into this shearing unit. A large circle cutting unit arranged in front of the column can be used for cutting circles larger than the gap and out of angular workpieces. This, as well as a small circle cutting unit, can be used for round beading and round flanging down. The nibbling unit has an adjustable eccentric disc, which drives the ram during operation. The nibbling die fixed by collet chucks turns round during the working process in the cutting plate. As turning of workpiece is not necessary, the working of long metal sheets with double the width of the gap is possible.

A new lathe, the "R530" (Fig. 22), built by Le Progres Industriel, is being shown for the first time in this country. It is designed for high precision production or toolroom work and swings up to 17½in over the bed or 11½in over the saddle between 39in centres. Drive to the all-geared headstock from the 10 h.p. motor is transmitted through vee belts and a double disc, multi-plate clutch operated from either the headstock or the apron.

Eighteen forward and reverse spindle speeds from 15 to 1500 r.p.m. are provided and an interesting speed selection pre-indicator is fitted. When a sliding knob on top of the head is positioned under the applicable column on a speed table three signal lights are illuminated to show how the levers must be set to give the proper surface speed on the given diameter. Through a quick-change gearbox forty different feeds for sliding and surfacing are available with a similar number of feeds for metric pitches,

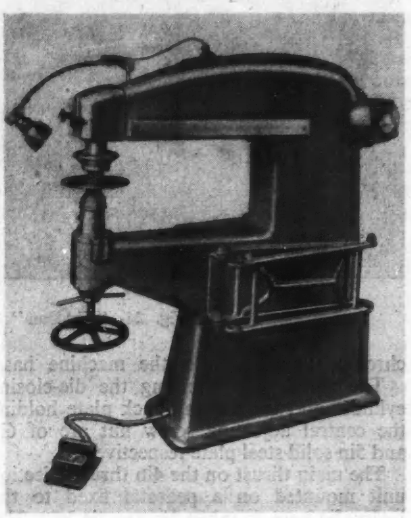


Fig. 23—Kunz Sheet Metal Working Machine—Soag

metric module pitches, diametral pitches, and U.S. standard pitches.

Part of the standard equipment is an automatic disengaging unit for the longitudinal carriage and the cross slide feeds. That for the carriage feed consists of a five-position turret stop on the apron and four stop brackets which can be set in different positions where it is required to stop the feed.

Other machines on this stand include a Buecher single-ended fine boring machine, three types of Graffenstaden milling machines, a Klink hydraulic horizontal broaching machine, a Nube cam milling machine, a group of Schmaltz grinders, and a W.G.W. hydraulic draw cut keyseater.

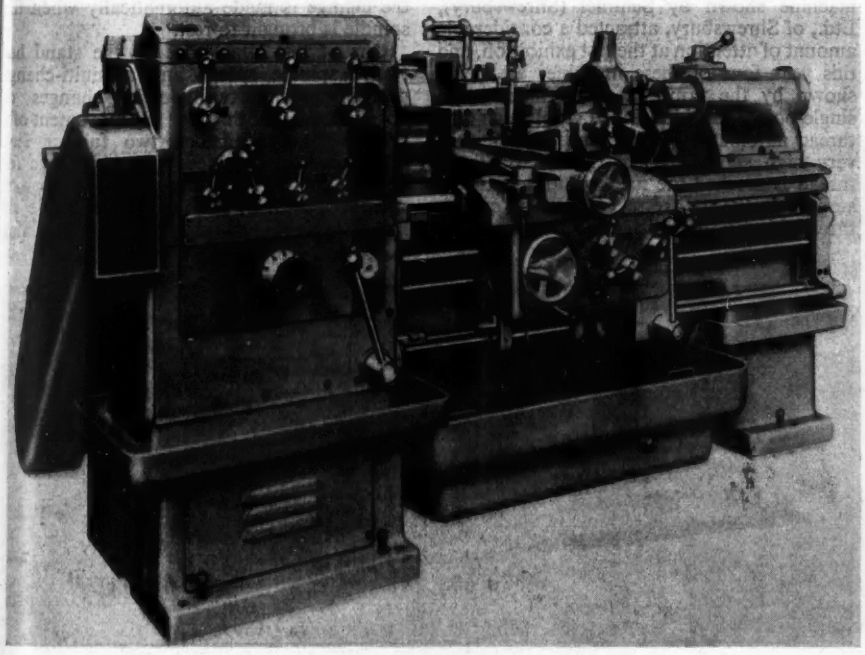


Fig. 22—"Progres" Lathe—Soag

Projectile and Engineering Company, Ltd.

The largest of two new self-contained, semi-automatic, die casting machines shown by the Projectile and Engineering Company, Ltd., of Acre Street, London, S.W.8, is a cold-chamber machine suitable for aluminium, magnesium and brass. If required the injection unit of this machine can be replaced with a hot chamber unit suitable for handling zinc, tin or lead. The machine has a capacity of 4 lb in aluminium, and it can be used with plungers from 1½in to 2⅝in diameter, the effective length of stroke being 9½in. With the largest plunger a pressure of 6000 lb per square inch is exerted on the material and with the smallest 18,350 lb per square inch, the injector plunger force being 33,183 lb.

In this machine die locking is carried out by a fully balanced, quick-acting toggle mechanism fitted with hardened and ground toggle pins operating in hardened and ground sleeves. Adjustment of the die space is effected by a 9½in diameter central screw with a buttress thread, and is easily made by operating a hand wheel. The thrust of the hydraulic lock at a pressure of 250 tons is taken by four 4in diameter high-tensile steel tension bars. The moving die platen of 5in steel plate is guided by four long phosphor-bronze bushes and its weight is taken by two additional bearing shoes running on hard

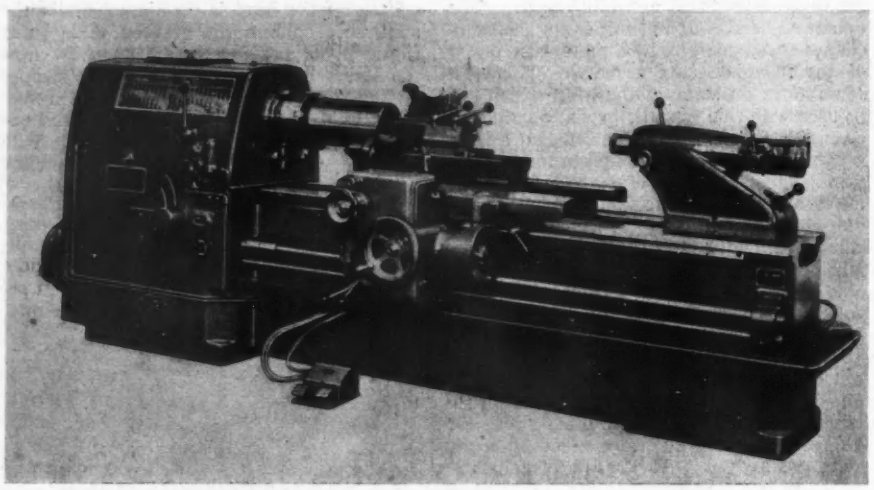


Fig. 24—" Cri-Dan " Threading Machine—Sentinel

chrome slides fixed to the machine base.

The thrust plate holding the die-closing cylinder and the moving back plate holding the central adjusting screw nut are of 6in and 5in solid steel plate respectively.

The main thrust on the 4in thrust injection unit mounted on a pedestal fixed to the hydraulic base is taken by two tie bars 2¼in diameter, anchored to the fixed platen. The height of the injection unit is adjustable by means of a hydraulic jack to provide central or below centre injection.

With the injection system used high speeds are possible without the extensive use of large valves, and with no drop in the line pressure. The injection cylinder unit gives a fast initial rate of injection, followed up with a high-pressure slow " squeeze." This change from high speed to high pressure occurs only when the molten material in the die cavity is packed under pressure and it is almost instantaneous. With this arrangement the danger of porosity in the casting or short shots is reduced to a minimum. A nitrogen bottle is provided for very high injection speeds should they be necessary for material such as magnesium.

A central hydraulic ejector cylinder built into the machine exerts a force of 11,000 lb and it is fully interlocked with all the other machine movements so that ejection is only possible at the required time during the cycle. The design of the electrical sequence control is such that the ejector can be used as a central core puller, a useful facility as it allows the core to be withdrawn when the dies are closed. When the hydraulic ejector is used as a core puller, or whenever central ejection is not required, an ejector plate can be used. Four ejector rods, two on each side of the platen, can be adjusted to strike a substantial ejector plate which covers the back of the moving platen from which the ejection movement can be transmitted to the die ejectors through any of the rows of conveniently spaced holes in the platen.

The electrical control equipment has been designed to eliminate the necessity for manual control, to maintain continuity and uniformity of production, and to give increased semi-automatic control output per machine-hour. All operations are initiated by push button, and the sequence in which individual operations take place during the cycle, before and after injection has taken place is infinitely variable. A system of interlocking ensures that when casting no operation can take place until the one immediately preceding it is satisfactorily completed.

The machine is semi-automatically operated, but means of manual operation are incorporated in the design should its use be required. A system of connections made on a panel can be easily altered by the insertion and withdrawal of small screws to select any cycle sequence. Push buttons are provided for manual control, each one being accompanied by a lamp indicating the button to be pressed for the next operation on successful completion of the last. With a separate set of push buttons provided for setting purposes, and enclosed in a lockable cover, all machine operations may be individually made with the automatic sequence of operation by-passed. An electric process timer accurately determines the cooling period during semi-automatic operation.

All the electrical control apparatus is housed in a sealed oil-proof cabinet attached to the front of the machine, access to the equipment being easily gained through a hinged front panel. For ease of maintenance the complete control unit can be uncoupled by the removal of two plugs and lifted from the machine for bench inspection.

Sentinel (Shrewsbury), Ltd.

The " Cri-Dan " semi-automatic threading machine shown by Sentinel (Shrewsbury), Ltd., of Shrewsbury, attracted a considerable amount of attention at the last exhibition, and this year four of these machines are being shown by the firm. In these machines a single-point carbide tipped tool cuts the thread automatically in a series of passes at very high speed. When the full depth of thread is reached the machine automatically stops with the tool retracted. When cutting threads the relationship between the rotation of the spindle and the travel of the tool slide is controlled by gearing between the spindle and a driven spline shaft along the front of the machine. This spline shaft drives a camshaft in the apron unit and a pick-off lead cam on the camshaft controls movement of the longitudinal slide. The profile of this lead cam determines the rate of slide travel and thus the pitch of the thread cut by the tool. A second limited movement cam is timed to withdraw the tool at the end of the cut and re-engage it at the beginning of the next stroke. A third cam gives the requisite amount of in-feed to the tool slide at each stroke until the required depth of thread has been cut.

The model " D " machine exhibited (Fig. 24) swings up to 12in over the saddle and 23in over the bed and admits work up to 5ft long between the centres. It cuts threads up to 5½in long and to a maximum depth of ¼in, and can be set to make up to fifty cuts per minute. The spindle is driven through a twelve-speed gearbox and vee belts by a 14 h.p. motor and the use of a back shaft doubles the number of speeds available, which range from 110 to 1180 r.p.m.

Another machine, which is illustrated on Plate 2, is built for turning and threading tubing internally and externally. Its spindle is bored 14¼in and it is fitted with hydraulically operated three-jaw chucks on the front and rear ends. On this machine threads up to 6½in long can be cut on tubes to a maximum depth of $\frac{5}{16}$in and up to thirty passes a minute can be made.

John Lang and Sons, Ltd.

The group of lathes made by John Lang and Sons, Ltd., Johnstone, Renfrewshire, includes two prototypes of a new design of the firm's 17in swing sliding, surfacing and screw-cutting machine. One of these lathes is designed for high-speed turning and its fast-head gives two ranges of eight speeds from a two-speed motor—a total of sixteen speeds from 14 to 2140 r.p.m. The four lower speeds in each range are by gear drive to the spindle, and the four higher speeds by belt drive. In the second machine a fasthead with twenty-four spindle speeds is fitted with a hydraulically operated gear change mechanism. With it the new speed is pre-selected whilst the machine is running and the change is made automatically when the spindle is brought to rest.

One of the 24in lathes on the stand has twelve spindle speeds and a multi-change gearbox giving twenty-eight changes of normal feeds and threads. By movement of a lever on the headstock two further feed ranges can be obtained, a coarse range for quick pitch screwcutting at the six lowest spindle speeds, and a fine range at the six fastest spindle speeds for fine finishing

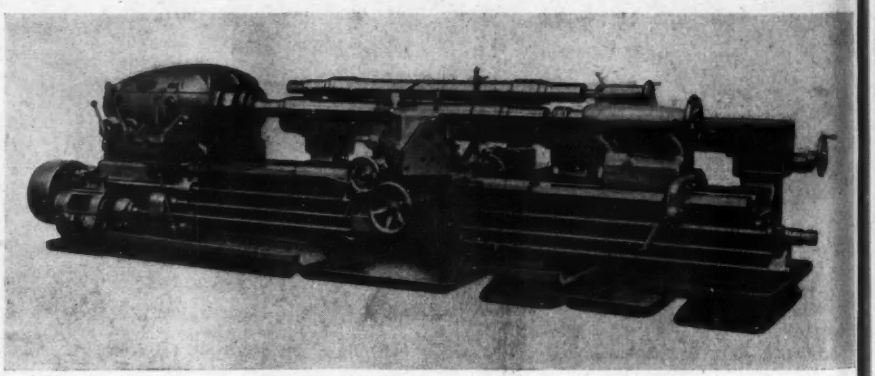


Fig. 25—20/24in Lathe with Profiling Attachment—Lang

purposes. A special attachment can be fitted to enable the cutting of leads up to 160in.

The 20/24in lathe, shown in Fig. 25, is fitted with a hydraulic profiling attachment (Fig. 26), with which stepped and taper shafts can be turned at one setting. A slide arranged on the saddle at 45 deg. to the axis of the lathe is operated by a hydraulic cylinder. The movement of this cylinder is controlled by a retraction valve which is superseded by a sensitive stylus when the stylus comes into contact with the master to be copied.

The master is mounted between centres at

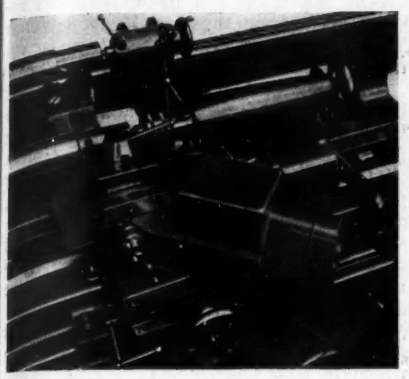


Fig. 26—Profiling Attachment—Lang

the rear of the machine in easy view of the operator. These centres can be moved longitudinally, separately or together, and adjusted for parallel in order to give easy and accurate setting. The distance "tool to stylus" is also adjustable to suit the final diameter of the work. Roughing cuts may be put on by the saddle screw until the stylus comes into operation for the final cut.

One of this firm's "Junior" lathes, arranged as a surfacing and boring machine, is illustrated on Plate 2. It is made in two sizes, 13in and 17in swing, and is fitted with a hexagonal turret to take six tools.

Monarch Machine Tool Company

The four lathes of the Monarch Machine Tool Company of the United States, which are to be seen in operation on the stand of the British agents, the Rockwell Machine Tool Company, Ltd., include the new model "T" machine designed for the finish turning and boring of jet engine rings and shrouds and other work of similar shape.

This right-angle machine (see Fig. 27) is fitted with the "Air-Gage Tracer" unit, through which any combination of straight sections and continuously varying contours can be bored and turned to a high degree of finish and accuracy. To give the maximum production it is fitted with two slides, one for turning and one for the boring operation. One slide of these machines is always fitted with a tracer unit, whilst the other can be provided with power angular feed only, or, as illustrated, equipped with tracer control as well.

The machine is generally fitted with a 40in diameter face-plate, and the distance between the face-plate and the tool slide is adjustable from 5in to 17in. A sixteen-speed geared headstock is driven through vee belts from an individual motor and gives spindle speeds from 6 to 330 r.p.m. Through a large handwheel the headstock can be adjusted laterally over a travel of 12in, and by this means work of considerable thickness can be handled without decreasing the maximum specified tool slide movement and tool working is kept at a minimum. A separate motor-driven feed and traverse unit provides either power feed or power traverse in each direction at 90 deg. to the spindle, and power feed or power traverse in each direction to the swivelling compound slide. When a second slide is fitted to the machine it is supplied with its own individual feed and traverse unit.

The swivelling tool slide fitted with an "Air-Gage Tracer" has its power unit mounted on a track at the front of the bed of the machine, and this unit can be positioned on the track in accordance with the size of the work, which determines the setting of the slide on the bed. A pedestal control panel provides start and stop to the headstock spindle and complete push-button control for the slide traverse and feeding motions.

Another interesting machine upon this stand is the 42in model 20 "Mona-Matic" high-speed automatic cycle, tracer-controlled lathe for single-point turning, illustrated in Fig. 28. This machine has a power-operated electronically controlled rear slide, which can be used for undercutting or rear forming operations. Geared headstocks with any of three spindle speed ranges are available for the machine, the top speed of each range being 900, 1850 or 2700 r.p.m. In each range the eight spindle speeds are set by means of pick-off gears and a tachometer at the front of the headstock constantly indicates the spindle speed. Power for operating the front gearbox and rapid traverse return is from an electronically controlled series motor, and it gives an infinitely variable feed range of from 3½in to 20in per minute with a rapid return movement of 85in per minute.

The independent rear carriage and slide is driven by its own feed and traverse motors and can be positioned at any required point along the bed. One of its motors provides power for slide traverse in or out at 85in per minute, and the other motor provides power for the in-feed of the slide at from ¼in to 9in per minute. The tool slide is set at a downward angle of about 20 deg. towards the centre to prevent chips from building up and give the operator a better view of the tools.

The slide of the tracer unit is mounted at an angle of 45 deg. on the front carriage and the template or master workpiece is mounted on a rail supported by a bracket at the right hand end of the machine. The angular setting of the tool slide enables square shoulders to be turned and the balanced movement of the air and hydraulic valves of the tracer control unit gives an immediate response of the slide to changes in the template profile. The feed of the hydraulically operated slide is infinitely variable from 0 to 20in. per minute.

An automatic feed change, which is available, permits variation of the feed to compensate for changes in depth of cut. It provides a means for retarding the feed on those sections of a blank which require an exceptionally high finish without sacrificing the time which can be gained from faster feeds over other sections of the workpiece. A rail mounted below the apron carries five adjustable trip dogs, which contact a control switch located in the bottom of the apron. Thus the unit gives five feed changes, which may be made to take place automatically at the desired time in the cut.

When a dual template control is used both a roughing and a finishing template are employed, the cycle being arranged in such a manner that the finishing cut automatically follows the roughing cut with no attention on the part of the operator. The roughing template, which is mounted below the finishing template, is only of sufficient length to guide the tool along that portion of the blank from which heavy stock removal is necessary, and

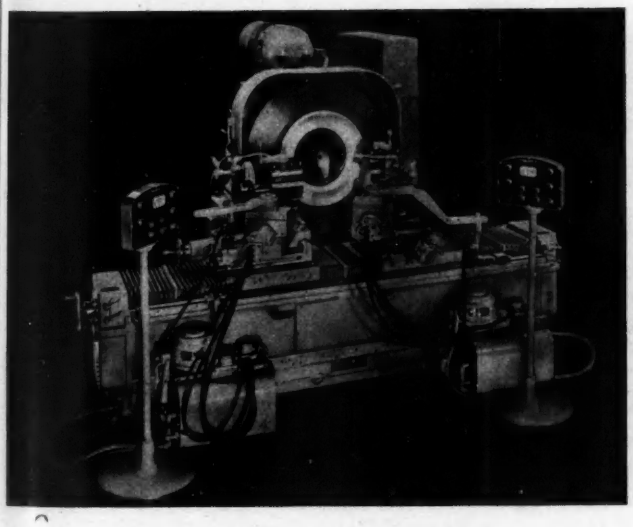


Fig. 27—Right-Angle Lathe—Monarch

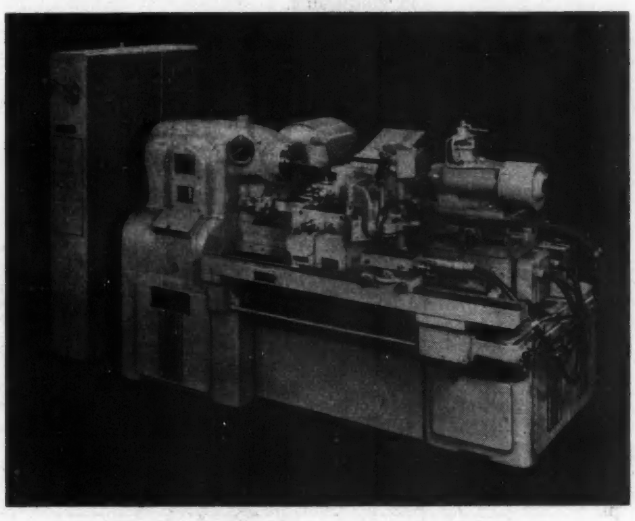


Fig. 28—"Mona-Matic" Lathe—Monarch

the finishing template guides the tool over the entire surface of the workpiece to be machined. Between the roughing and finishing cuts the entire hinged template rail assembly moves the finishing template into operative position through the medium of a ratchet operated cam. The roughing template is returned to operative position in the same manner at the end of the cycle.

Snow and Co., Ltd.

A range of heavy-duty precision surface grinders made by Snow and Co., Ltd., Stanley Street, Sheffield, includes the completely redesigned model "O.S.72," illustrated on Plate 1. This machine has a capacity of 72in by 18in by 20in and it can be supplied with a 72in by 18in magnetic chuck.

The table of this machine is traversed hydraulically on vee and flat bedways and the stroke is controlled by adjustable trip dogs. The box section bed housing the hydraulic control gear is of sufficient length to ensure that the table is fully supported in all positions of its travel.

The cross saddle carrying the wheelhead is mounted vertically on the column slideways, the weight of both being counterbalanced to ensure a sensitive, smooth feed movement. The cross saddle is guided by ball-bearing rollers mounted on the side faces of its vertical shears. These rollers are preloaded on to the side slideways of the column to give a vertical motion with a minimum friction and to eliminate side movement. Vertical feed is applied manually by means of a conveniently placed handwheel, and a fine feed motion also provided is calibrated to read in 0·0001in. Power elevation of the cross slide and wheelhead unit is controlled by a single lever situated to the left of the vertical feed handwheel and is interlocked to ensure that the hand mechanism is isolated when power is engaged.

The wheelhead can be operated automatically or by hand, and the hydraulic cross traverse can be applied intermittently at each reversal of the table or continuously for quick setting or wheel truing purposes. Reversal of the hydraulic cross traverse motion is independent of the table movements, the length of stroke being determined by dogs on a circular dial fitted to the control panel. Fine hand cross feed is also provided with calibrations reading to 0·00025in.

The wheelhead is carried on the long slideways of the cross saddle, which extend over the machine table and are of such a length that the head slideways never overhang in extreme positions. The grinding wheel spindle is driven by a directly mounted 20 h.p. motor.

The vertical surface grinder shown on the stand and illustrated in Fig. 29 has a working capacity of 72in by 15in. It has steplessly variable table speeds from 5ft to 80ft per minute and any predetermined slow speed for finish grinding is obtainable through vernier adjustments on the table control lever.

The column carrying the wheelhead is adjustable in all directions for correcting alignment with the work table. The wheelhead is counterbalanced to ensure sensitive feed motion, and a totally enclosed 30 h.p. motor incorporated in the head has its rotor mounted directly on the spindle, which runs at 960 r.p.m. The machine uses a grinding wheel of the "outside" segment type. With this 18in. diameter wheel the whole of the table surface is covered at each traverse.

The vertical feed is applied automatically or by hand. The automatic feed operates at each reversal of the table and is variable from 0·00025in to 0·003in. A micrometer dial device enables settings to be made rapidly to 0·0005in and automatic trip is provided. The maximum height from table to grinding wheel is 18in.

Humphris and Sons, Ltd.

The presses exhibited by Humphris and Sons, Ltd., of Parkstone, Dorset, include a new 20-ton inclinable crank machine, which operates at 100 strokes a minute and incorporates a rolling key clutch, top ejector, top roll release for piloted tools, screw inclining gear, and built-in flush-mounted switchgear. It is shown fitted with one of the firm's double roll feed devices, which has a maximum capacity for $\frac{1}{16}$in thick, 9in wide stock and gives a 6in forward feed.

One of the maker's improved 10-ton overhung crank presses is fitted with a new interlocking dial feed and is suitable for secondary pressing operations and light assembly work. The dial feed has six operating stations on a 9in. pitch circle diameter, the maximum diameter of the holes in the dial plate being 4in.

Two new self-centring coil stands shown have capacities for 300 lb coils of 6in wide material and can be arranged for free running or powered operation with float switch control.

S. Russell and Sons, Ltd.

The way in which the cold sawing machine has been developed into a high-speed automatic machine to meet modern production requirements can be seen in the units of recent design exhibited by S. Russell and Sons, Ltd., of Leicester. This company makes several designs of hydraulic and mechanical feed cold sawing machines and hot sawing machines, but owing to space restrictions it is only showing four models of its "Hydrofeed" high-speed cold saws and two automatic saw sharpening machines.

The latest design of fully automatic cold sawing machine is made by the firm in three sizes, and the one exhibited, illustrated in Fig. 30, cuts rounds or squares up to 6in. In this machine the cycle of operations—feeding the bar the required length, clamping, engagement of saw feed, quick return of the saw saddle on completion of the cut, and unclamping the material—is entirely automatic and needs no attention from the operator.

The heavy box section cast bed of this machine has machined slideways, upon which the large saw saddle is traversed in and out across the bar by hydraulic power. A 5 h.p. motor drives the saw spindle through spur and double helical gears. A four-speed gear included in the reduction gearing gives a range of four peripheral cutting speeds of 25½ft, 41ft, 58ft, and 74ft per minute to the 20in diameter saw. A hydraulically operated vertical vice has its pressure cylinder built into the vice body and the press block is forced down on to the material through a toggle mechanism, so transferring the holding pressure to mechanical components.

When the machine is set for automatic cycle working the material to be cut is carried between gripper jaws. At the commencement of the cycle these jaws grip the stock, which is then moved forward a distance equivalent to the required cut-off length of the component, loss of material during cutting being compensated for automatically. The interlocking vices then clamp the material and the saw automatically feeds forward at the set rate. During the cutting operation

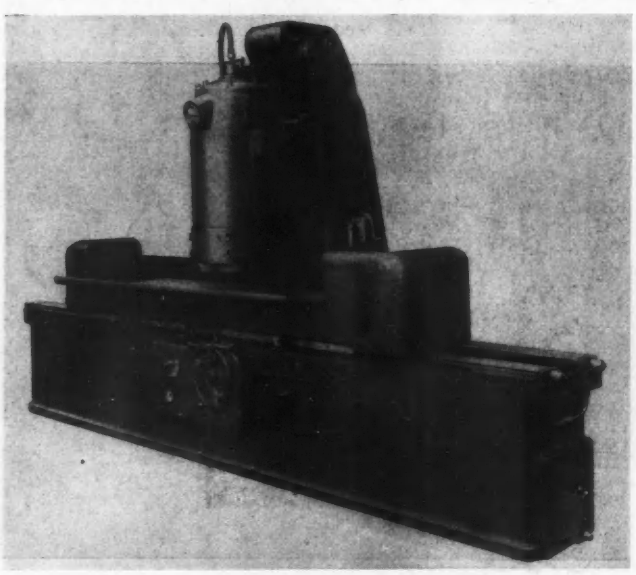


Fig. 29—Vertical Surface Grinder—Snow

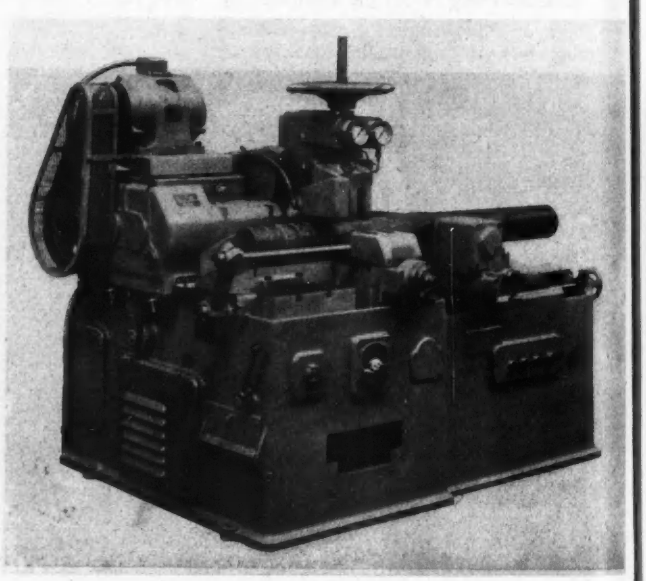


Fig. 30—Automatic Cold Sawing Machine—Russell

the grippers are automatically released and they return to their original position. Upon completion of sawing the saw saddle quickly returns, and at the same time the grippers close on to the stock. As soon as the saw saddle comes to rest in its rearmost position the vices are released and the stock is then moved forward, and the automatic cycle recommences.

This firm's "11/40" automatic saw sharpening machine was first shown at the 1948 exhibition. Since that time detailed improvements have been made, although the machines' appearance is but little changed. In modern segmental saw blades each alternate tooth is bevelled and ground so that it projects higher than the following tooth. This system of tooth form splits the chip in such a manner that the leader tooth removes the centre portion and the follower tooth takes out the remainder. The cutting angle is varied to suit the particular material to be sawn. The machine shown is capable of grinding the height difference between the leader and the follower teeth automatically and it can easily be set to any cutting angle normally used.

Thos. W. Ward, Ltd.

A new Woodhouse and Mitchell 8½in centre lathe included amongst the exhibits of Thos. W. Ward, Ltd., of Albion Works, Sheffield, is intended for high-class production work. This machine (see Fig. 31) admits work up to 48in. long between centres and swings up to 17in. over the bed or 10½in over the saddle. A gap with a removable bridge is set in the bed and in this gap work 9in. wide by 28in diameter can be swung.

The rigid box-section bed is mounted on a fabricated steel base which houses the motor and switchgear and also forms a chip tray. A combined sliding gear and clutch change headstock provides a range of twelve spindle speeds in geometric progression from 12 to 945 r.p.m., and these speeds are selected in the ranges of three by two levers. A clearly marked colour coded speed plate facilitates rapid selection. The main spindle —a large diameter heat-treated high-tensile steel forging, bored with a 2⅞in diameter hole—is mounted on opposed heavy duty precision taper roller bearings. Control of sliding and surfacing motions is effected by large-diameter clutch with sensitive lever operation and selection of desired motion is by an additional lever. This latter lever also selects a coarse or fine feed for either sliding or surfacing action. Forty-two fine and coarse sliding and surfacing feeds are available and the sliding feeds range from 0·0037in to 0·103in per revolution of the spindle, whilst the surfacing feeds are from 0·0019in to 0·052in per revolution.

The machines of Continental manufacture on the stand include the Italian-built "Rigiva" vertical milling machine, illustrated on Plate 4. This machine is intended for production or toolroom use and its table has a 55in by 12in working surface with a longitudinal power traverse of 42in, a cross traverse of 13in and a vertical movement of 17in. A 5½ h.p. motor provides the drive for the spindle and feed motions through a gearbox, and all feeds and speeds are selected by levers on two graduated quadrants at the side of the machine. A useful range of twelve reversible spindle speeds from 18 to 1800 r.p.m. are available with twenty-four power feeds from ⅜in to 18in per minute. Rapid power traverse of 63in per minute is available for the longitudinal and transverse table movements and 43in per minute for vertical traverse.

An "Eldair" 8ft by ¼in capacity guillotine shear upon this stand (Fig. 32) incorporates modern lines with good visibility and free working. The frame of this overdriven machine is built up of rolled steel plates, the side housings having machined pads welded on them to carry the main crankshaft bearings, bed and top tie beam. The slideways for the top beam are faced with carbon steel to reduce wear and the bed and top tie beam are keyed into the parent metal of the side housings so that they have a direct bearing without using welded joints.

The rigid box-section welded bed is carried on keys fixed into the side housings, and it is adjustable forwards and backwards for accurate setting of the blades. Recesses in the top enable the blade bolts to be removed from above the bed and these recesses are normally covered with a steel plate which fits flush with the top of the table.

The top beam is of welded box section, and to its end faces are bolted cast iron slides, which work in the cast steel slideways in the side housings. The wrist pins of the connecting-rods are carried in lugs protruding from the front face of the beam, and the small ends of the rods fit into thrust pockets to eliminate any tendency to shear the wrist pins.

The top tie beam is keyed and bolted to the side housings and carries a centre crankshaft bearing and top beam balancing springs.

Drive is taken from a 12 h.p. motor on top of the right-hand side housing by three vee belts to a flywheel mounted on a first motion shaft. From this shaft the drive is transmitted to the crankshaft through totally enclosed double reduction gears and a four-jaw dog clutch operated from a pedal shaft running the whole length of the machine.

Cams on the crankshaft operate a hold-down moving in slideways on the side housings, pressure being applied by spring-operated plungers, to hold the plate being sheared

All the working and moving parts are covered by a shroud at the front of the machine and view of the plate for line shearing is afforded through a Perspex screen running the length of the machine.

F. E. Rowland and Co., Ltd.

Together with some representative models of its wide range of abrasive wheel cutting-off machines, F. E. Rowland and Co., Ltd., of Reddish, near Stockport, is showing two examples of duplex grinders which it makes for dealing with many different types of components which require grinding on two opposite sides. These duplex grinders are particularly intended for high rates of production, and are arranged in various ways with special feeding fixtures suited to the shape, size and nature of the components being handled.

For dealing with work which must be held rigidly, and where a large amount of material has to be removed, such as in the case of turbine blades for aircraft engines, a machine like that shown in Fig. 33 is used. It is fitted with an oscillating work holder and is arranged for a continuous wheel feed at a predetermined and variable rate.

This machine has a box section fabricated steel bed on the top of which are heavy section cast iron slideways carrying two grinding wheel heads. Each head is driven by its own 40 h.p. motor through vee belts and has a high-tensile steel spindle mounted on precision pre-loaded angular contact bearings at the front and roller bearings at the driving end. The spindles carry 30in diameter solid abrasive discs.

Fitted on the front of the main bed is a double-link oscillating arm which carries a rotatable double fixture with each end arranged to take two blades. These fixtures are arranged for automatic clamping during the grinding process by means of cam-operated levers. The fixture is located in a

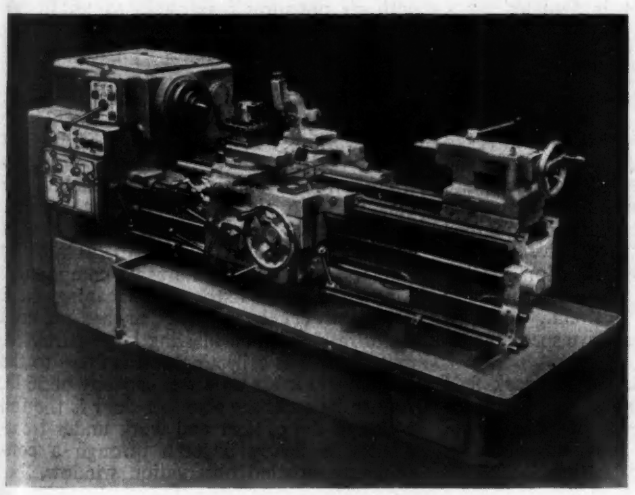


Fig. 31—8½in Lathe—Ward

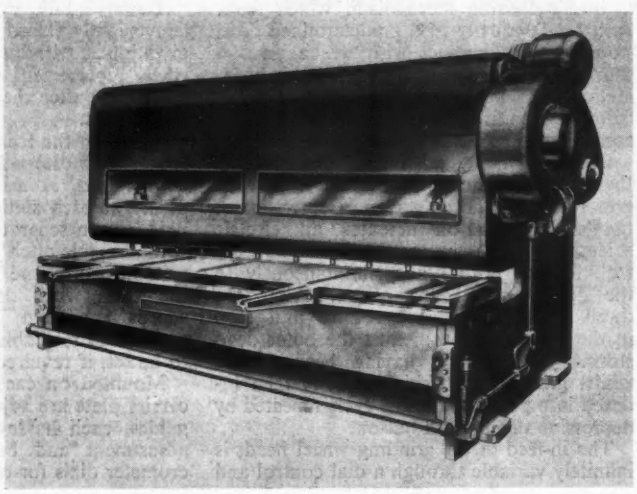


Fig. 32—Guillotine Shearing Machine—Ward

grinding position by a spring-loaded plunger and is rotated after withdrawal of this plunger by a ratchet handle. The rotation of the fixture automatically clamps the work to be ground and releases the two components previously ground.

Automatic sizing of the work is provided for by means of "electro-limit" switches, one at each side of the fixture. The thickness of the component is measured after grinding prior to unclamping and automatic compensation is made for wheel wear when the component is reaching the top limit allowed. The gauging unit causes a hydraulic compensating feed cylinder to operate and move the grinding wheel heads inwards by the required amount due to wheel wear. Mounted in a convenient position on the wheel guard are two adjustable entrance guides, which centralise the work in the holder prior to clamping. Hydraulic power for the machine is provided by a motor-driven pump, which, together with the requisite valve control gear and the conveniently located electrical push-button station, provides means of convenient and rapid operation.

The machine is fitted with controlled cycle hydraulic feeding mechanism, which feeds both heads equally to a predetermined dead stop position, contact with which gives a short dwell period before reversal automatically takes place. This dwell is variable from between five seconds and thirty seconds, according to requirements.

Operation is by push button controlling the cycle from the starting position with the grinding wheel heads open. Depression of the starting button actuates an electric solenoid which operates the hydraulic control, feeding both heads simultaneously to the dead stop at the centre. After the dwell period the heads reverse and stop in the open position against the outer dead stops. The fixture, having been loaded whilst grinding is taking place, is then indexed into position and the cycle repeated by depression of the push button.

The in-feed of the grinding wheel heads is infinitely variable through a dial control and a separate similar control is fitted for the variation of the rate of oscillation of the work feed arm.

For parts such as small permanent magnets and other things which cannot be held rigidly during grinding a machine with a rotary work carrier, such as that illustrated on Plate I, is used. In this unit the carrier disc is provided with a series of holes, into which the work is loaded for passage between the grinding wheels.

Mounted between the bed slideways of this machine are two hydraulic cylinders with double extension piston-rods. The inner ends of these rods are coupled by means of a crosshead and rack and pinion unit situated on the centre of the bed to ensure that load imposed on the cylinder is distributed to impart equal motion in either direction of each grinding wheel head. The opposite end of the piston-rod passes through a nut mounted on a bracket attached to each grinding wheel head, and this nut has a calibrated dial. These nuts provide means for centralising each grinding wheel head relative to the feed disc centre and means of compensation in case of unequal wheel wear.

The hydraulic cylinder is actuated by a conveniently placed lever, operation of which gives rapid withdrawal for wheel truing or wheel replacement or rapid advance up to dead stop after these operations have been carried out.

Fitted on the front of the main bed is the rotary feed disc drive unit, into which the components, in this case the magnets, are placed as each station passes. Drive to the unit is by a separate ½ h.p. motor equipped with variable-pitch vee rope drive through suitable worm and wheel reduction gear to the main work drive spindle. The disc speeds are from 1 to 3 r.p.m., and two pick-off gears enable alternative speed ranges to be set, if required.

Mounted on each side of the work feed carrier plate are adjustable entrance and exit guides, each having means of independent adjustment and being provided with micrometer dials for ease of setting.

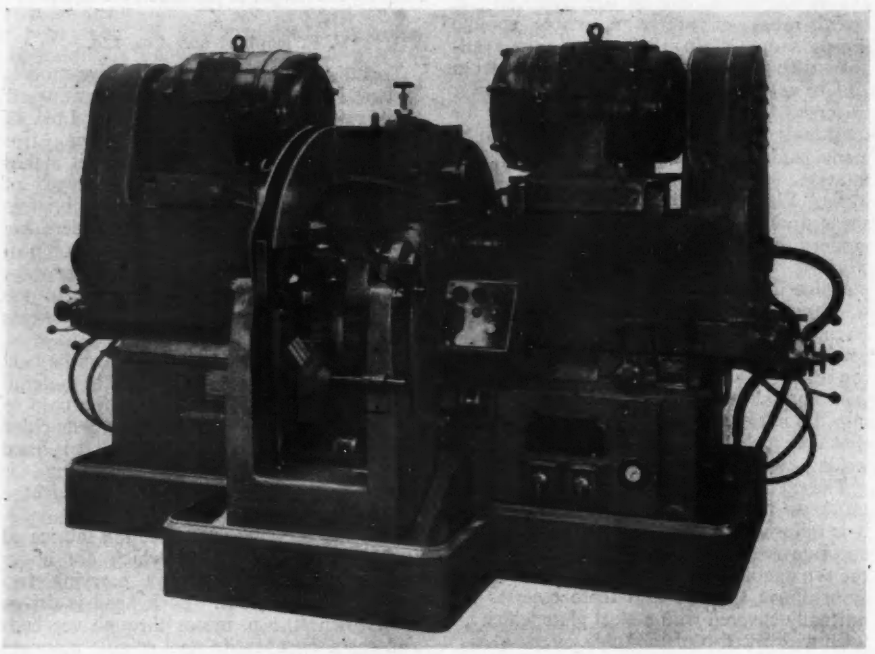


Fig. 33—Duplex Surface Grinder for Turbine Blades—Rowland

As with the machine first described, electro-hydraulic wheel compensation is fitted to enable the size of the component to be controlled and take care of the normal wear of the grinding wheels.

One of the 16in. abrasive wheel cutting-off machines being demonstrated uses a tungsten carbide tipped saw to cut off phosphor-bronze and brass alloys and aluminium alloys at high production rates to close limits of accuracy.

Guyson Industrial Equipment, Ltd.

A shot blasting unit of medium size frequently forms a very useful piece of ancillary equipment for toolrooms and machine shops, and some examples of the range of cabinets made by Guyson Industrial Equipment, Ltd., North Avenue, Otley, Yorks, are to be seen on that firm's stand. In addition to its three standard cabinets, having chambers 20in. by 20in by 28in, 32in by 22in by 28in, and 42in by 30in by 38in, this company has recently introduced a useful bench unit for shot blasting work in small workshops, laboratories, &c. This cabinet is 34in by 16in by 24in and is supplied as a complete unit with its own motor-driven extractor and two-stage filtration dust collector. It operates with air pressures from 30 lb to 150 lb per square inch and when working at 100 lb per square inch consumes 6½ cubic feet of air per minute.

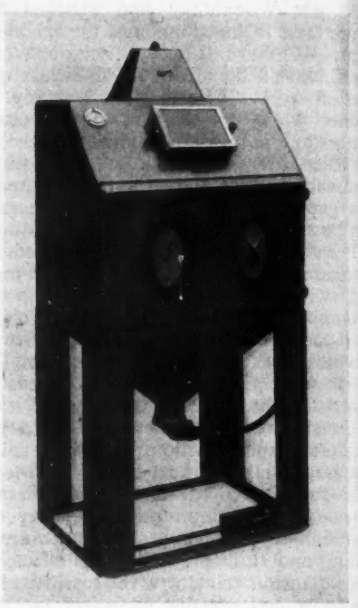


Fig. 34—Shot-blast Cabinet—Guyson

The intermediate sized standard cabinet made by the firm is illustrated in Fig. 34. It has a working chamber 32in by 22in by 28in and is designed to work with air pressures from 30 lb to 150 lb per square inch. The blast gun is a suction-operated pistol with a dual-purpose fitting and it handles steel abrasive from "fines" up to No. 20 mesh or similar sizes in other abrasive compounds. This gun can be fixed when cleaning small parts easily held by hand, or detached and used pistol fashion when blasting large parts. A motorised dust collecting unit is fitted to the cabinet and it has a hopper capacity of 56 lb. As can be seen, the chamber door is the full width of the cabinet and work under treatment can clearly be seen through a conveniently situated observation window.

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